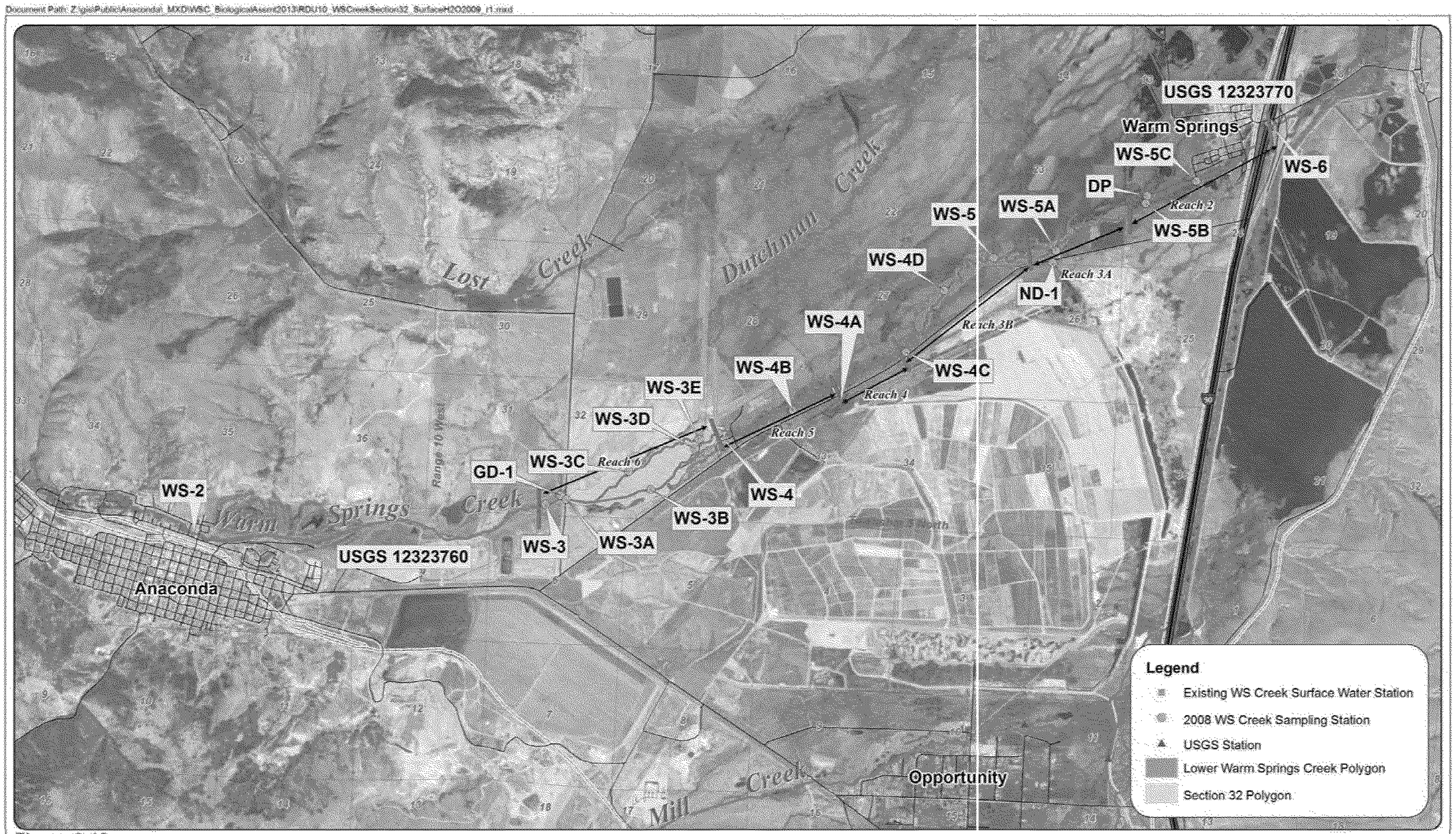

Figure 2-12
Warm Springs Creek Surface Water Sampling Locations
RDU 10 Warm Springs Creek
Anaconda Regional Water, Waste and Soils OU
Anaconda Smelter NPL Site, Montana

The proposed design of the reconstructed reach is based on "reference reach" data collected to identify typical stream plan, profile, and cross section geometries. A suitable, 1,400-foot reference reach was identified approximately 0.5-miles upstream of the Lower Warm Springs Creek Project Area, running along the south boundary of the ADLC Airport. Cross section data (i.e., width, cross-sectional area, mean depth, max depth, etc.) was collected at various channel feature locations (i.e., riffles, runs, pools, and glides). Profile characteristics including average water surface slope, riffle slope, pool-to-pool spacing, and pool length were surveyed along with channel pattern features such as mender length, meander radius and belt width. More details on the reference reach can be found in the Lower Warm Springs Creek Reference Reach Report located in Appendix E, Sub-part 6 of the RAWP (Atlantic Richfield 2013).

The Section 32 reference reach begins at the Galen Road Bridge and continues downstream approximately 1,000 feet. The reference reach is largely a uniform riffle with cobble-boulder substrate. Very little fine sediment is present and the water is clear, fast-flowing, and cold. Due to an absence of fine sediments, embeddedness of larger substrates is very low and depositional features are absent. The Section 32 reference reach is largely a straight channel section with few meanders. Some microhabitats are present, including small scour pools along banks and low-velocity areas behind larger boulders. The reference reach is connected to its floodplain during 10-year flood events. The forested riparian buffer consists primarily of large cottonwoods and is approximately 30-feet wide. More details on the Section 32 reference reach, including cross sections and pebble counts, can be found in Appendix E, Sub-part 5 of the RAWP (Atlantic Richfield 2013).

Reach 5 (**see Figure 2-12**) near the ADLC airport, is relatively well vegetated and stable and the source of metals loading in this reach has not been identified. Reach 5 is within the Yellow Gopher cultural resource area. Consequently, there is a preference to limit removal in order to preserve this area.

RA can be prioritized to include the Lower Warm Springs Creek Project Area and Section 32. RA in Reach 5 can be postponed to observe improvements that occurred as a result of RA in the first two project areas and see if further RA is needed. Postponement will result in preservation of existing vegetation and relatively stable stream banks in Reach 5 (**Figure 2-12**) (CDM Smith 2012).

RAs conducted at both project areas are expected to achieve the surface water quality performance standards. Note that additional RAs to be taken in the vicinity of Warm Springs Creek, including remediation of parcels near the former Arbiter Plant under the Old Works OU, and remediation of LRES polygons east of Galen Road under the RDU 7 RA, are expected to also reduce COC loading to Warm Springs Creek through reduction of surficial COC concentrations and establishment of vegetation.

2.1.4 Protective Measures

Removal of fluvial wastes and soil/waste mixtures identified in the FDR (CDM Smith 2012) would reduce arsenic and copper concentrations below the applicable cleanup level of 1,000 mg/kg within RDU 10 (Atlantic Richfield 2013).

Some areas of high quality vegetation are present in the Section 32 and Lower Warm Springs Creek project areas, including thick stands of willow, alder, birch, and cottonwoods in riparian areas. It would not be practicable or desirable to damage mature vegetation in order to remove minimal soils/waste mixture deposits in such settings. Care must be exercised to avoid damage to existing vegetation wherever removal of contaminated materials is contemplated. Unavoidable impacts to vegetation to remove significant soil/waste deposits might require vegetation restoration in order to stabilize the stream bank.

Removal is preferred to treatment, and complete removal of contaminants of concern (COCs) is preferable to partial removal; however, partial removal is permissible in order to preserve good quality vegetation.

RAs conducted at both project areas are expected to achieve the surface water quality performance standards.

While removal is the preferred alternative for the remediation of contaminated mixed soils and waste from the floodplain, as noted in Section 4.2, the 2011 ARRW&S ROD Amendment (USEPA and MDEQ 2011) requires "minor amounts of waste removal" in Section 32 and an estimated 40,000 cubic yards of waste removal in the Lower Warm Springs Creek Project Area. Treatment is permissible outside of these areas and the unstable portions of the stream channel. Treatment alternatives will require storm water run-on and runoff best management practices (BMPs), especially during the first few years after remediation before vegetation performance standards have been achieved. BMPs are established to reduce the potential for transport of COCs to the stream.

The final design for the RDU 10 Warm Springs Creek Project Area requires removal of wastes and soil/waste mixtures containing elevated COC concentrations where they are likely causing metals loading to the stream. Wastes would be transported to the Opportunity Ponds WMA for disposal.

Removal areas would be backfilled with clean fill and soil when necessary. Streams would be realigned into abandoned channels or newly constructed channels, or stream banks would be stabilized with appropriate riparian vegetation and BMPs. These are considered soft engineering approaches. The stream would be further protected by implementing institutional controls such as grazing restrictions or other land use restrictions, and future monitoring and maintenance of the stream and Project Area. Each of these elements of the final design is discussed below.

Various stream bank stabilization methods have been developed for Class 1, Class 2, and Class 3 stream banks, as appropriate. The primary intent of this stream bank stabilization is to reduce the potential for COCs to become re-entrained during high flow events. One focus of the stream bank stabilization design proposed in the RAWP involves reducing the potential for stream migration into potentially contaminated areas.

After RA construction is complete, grazing by livestock would be prohibited until vegetation becomes established. After vegetation is established, some restrictions on grazing would be required to prevent over-grazing. Because most of the project areas lie within the floodplain, existing floodplain restrictions on development also serve as an institutional control to protect the integrity of the remedy.

2.1.5 Monitoring

The design presented in the FDR represents a partial removal; therefore, surface water performance and compliance monitoring would be required. Conceptually, stream water quality samples would be collected eight times per year at USGS monitoring station 12323770 (i.e., ARWW&S OU sampling station WSC-6). Samples would be collected during high and low flows, but would focus on the high flow period. If elevated concentrations of COCs are detected under this monitoring program, the stream would be re-evaluated and additional monitoring or contingency remedies may be required.

Final surface water monitoring and maintenance requirements would be established under separate site-wide monitoring and maintenance plans (CDM Smith 2012).

Turbidity monitoring, similar to the program used during the Milltown Dam removal, should be conducted during RA construction in the stream corridor to ensure that BMPs designed to minimize sediment transport to the stream are functioning properly. Protocols for inspection and maintenance would be set forth in a final Inspection and Maintenance Plan, to be developed after RA construction is completed.

2.2 Implementation of the Proposed Action

The RAWP (Atlantic Richfield 2013) sets forth task-specific methods or approaches, schedules, and other provisions to comply with performance standards and other criteria required by the Record of Decision (ROD) (USEPA and MDEQ 1998) and 2011 ROD Amendment (USEPA & MDEQ 2011) as well as those identified in the Warm Springs Creek FDR (CDM Smith 2012).

The specific design for Warm Springs Creek is included in two documents, the FDR and the RAWP for RDU 10. The FDR for the Warm Springs Creek project areas was developed by the U.S. Environmental Protection Agency (USEPA) to provide the conceptual Warm Springs Creek Remedial Design (RD) and includes design investigation summaries, RAOs, the Selected Remedy, and remedial requirements of the ARWW&S OU ROD and 2011 ROD Amendment; Design considerations, constraints, and assumptions to be addressed and factored in during development of the RAWP; and the Final RA design elements (e.g., source controls, removal, bank stabilization options, etc.) and directives for completing the remedial design and RA.

Prior to developing the RAWP, a kickoff meeting between the regulatory agencies and Atlantic Richfield was held in September of 2013 to discuss critical design elements. These design elements included the following:

- Bank full flow event
- Bank stabilization treatment design storm
- Proposed types of treatments
- Floodplain reconstruction, secondary channels, swales, etc.
- Meander belt –Riparian Zone
- Interaction with Groundwater
- Potential issues with changing channel configuration and how it could affect groundwater
- infiltration, i.e., gaining/loosing stream sections
- Interaction of overflows with Dutchman Creek
- Interaction of tributaries, if any
- Water rights issues – irrigation ditches
- Land ownership

- Vegetation requirements

Other discussion items included the following:

- Discussion of alternatives to deal with the island, the alluvial fan, and secondary channels
- Discussion of potential remedies to reduce the potential risk of water flowing towards Dutchman Creek (i.e., installing a berm or lowering the channel bed)
- Discussion of potential obstructions (e.g., debris, ice jam, structures, fences, beavers)
- Results of the Hydrologic Engineering Centers River Analysis System (HEC-RAS) Model

Because of the relatively flat topography, the regulatory agencies strongly recommended that a LiDAR survey be completed of the Section 32 Project Area. Results of the LiDAR survey are included as part of the RAWP (Atlantic Richfield 2013).

Section 3

Environment Baseline

3.1 Listed Species, Critical Habitat, and Species of Concern in the Action Area

3.1.1 Animals

The Montana National Heritage Program (MNHP) documents 30 animal species of concern for Deer Lodge County. Of the 30 species of concern, 19 species with federal designations either from the United States Fish and Wildlife Service (USFWS), United States Forest Service (USFS), and/or Bureau of Land Management (BLM) have been included in **Table 3-1.** Of these, four are listed federally by the USFWS as either candidate [i.e., greater sage grouse, Arctic grayling (upper Missouri River DPS), and wolverine] or threatened (i.e., bull trout). Designated critical habitat is also associated with the bull trout listing. Other USFWS associated listings include recovered, delisted, and being monitored (DM) designations for the bald eagle and peregrine falcon (MNHP 2013).

Additional wildlife regulations and designations applicable to species documented to exist in Deer Lodge County include the BGEPA for the bald and golden eagle, birds of conservation concern (BCC) for the bald and golden eagle, and the MBTA for the bald eagle, black-crowned night-heron, Brewer's sparrow, golden eagle, great gray owl, long-billed curlew, northern goshawk, and peregrine falcon (**Table 3-1**) (USFWS 2012b). As mentioned in Section 1 of this document, the MBTA also includes regulations that apply to most native birds of North America. These regulations include protection against their taking, their eggs, parts, and nests, except when specifically permitted. If work must take place during the breeding season or at any other time which may result in take of migratory birds, their eggs, or active nests, USFWS recommends that the project proponent take all practicable measures to avoid and minimize take (MNHP 2013).

USFS and BLM listed species included in **Table 3-1** include USFS and BLM sensitive species, USFS threatened species, and BLM special status species. The USFS sensitive species include western toad, bald eagle, greater sage grouse, peregrine falcon, Artic grayling, westslope cutthroat trout, Yellowstone cutthroat trout, western pearlshell, fisher, pygmy rabbit, and wolverine. Only the bull trout is listed as threatened with the USFS. All 19 species listed in **Table 3-1**are listed as sensitive with BLM except for bull trout, for which BLM has designated as special status (MNHP 2013). Figures depicting locations where animal species of concern have been identified in relation to the project areas can be found as **Figures A-1, A-2, A-3, and A-4 in Attachment A.**

Table 3-1 Animal Species with Federal Designations – Deer Lodge County, MT

Common Name	Scientific Name	USFWS	USFS	BLM	Preferred Habitat	Notes
Amphibians						
Western Toad	Anaxyrus boreas		Sensitive	Sensitive	Wetlands, floodplain pools	Not expected in Warm Springs Creek (WSC) project areas. The only occurrence is more than 20 miles to the southwest, outside of the Columbia River Basin watershed.
Birds						
Common Name	**Scientific Name**	**USFWS**	**USFS**	**BLM**	**Preferred Habitat**	**Notes**
Bald Eagle	Haliaeetus leucocephalus	DM; BGEPA; MBTA; BCC	Sensitive	Sensitive	Riparian forest	Bald eagles are present in the vicinity of WSC, with documented activity to the northeast (over 2 miles) of the project areas.
Black-crowned Night-Heron	Nycticorax nycticorax	MBTA		Sensitive	Wetlands	Black-crowned night-herons are documented as close as 1 mile from the Lower WSC project area. Habitat is also present along the entire length of both project areas.
Brewer's Sparrow	Spizella breweri	MBTA		Sensitive	Sagebrush	Brewer's sparrows are not expected near the project areas. The closest occurrence of this species is over 20 miles to the southwest.
Golden Eagle	Aquila chrysaetos	BGEPA, MBTA, BCC		Sensitive	Grasslands	Golden eagles are present in the vicinity of WSC, with documented activity to the west (over 15 miles) of the project areas.
Great Gray Owl	Strix nebulosa	MBTA		Sensitive	Conifer forest	Conifer forest habitat does not occur in the vicinity of the project areas; therefore great gray owls are not expected. The closest occurrence is over 20 miles to the northwest and southwest of the project areas.
Greater Sage Grouse	Centrocercus urophasianus	C	Sensitive	Sensitive	Sagebrush	Not expected in WSC project areas. They are documented to occur more than 25 miles to the southwest, outside of the Columbia River Basin watershed.
Long-billed Curlew	Numenius americanus	MBTA		Sensitive	Grasslands	Long-billed curlews are documented as close as 1 mile from the Lower WSC project area. Foraging habitat may be present in the vicinity of both project areas.
Northern Goshawk	Accipiter gentilis	MBTA		Sensitive	Mixed conifer forests	Mixed conifer forest habitat does not occur in the vicinity of the project areas; therefore northern goshawks are not expected. The closest occurrence is over 15 miles to the west of the project areas.
Peregrine Falcon	Falco peregrinus	DM, MBTA	Sensitive	Sensitive	Cliffs / canyons	Cliff and canyon habitat does not occur in the vicinity of the project areas; therefore peregrine falcons are not expected. The closest occurrence is over 6 miles to the northwest of the project areas.

Table 3-1 Animal Species with Federal Designations – Deer Lodge County, MT (continued)

Common Name	Scientific Name	USFWS	USFS	BLM	Preferred Habitat	Notes
Fish						
Arctic Grayling (Upper Missouri River DPS)	Thymallus arcticus	C	Sensitive	Sensitive	Mountain rivers, lakes	Not expected in WSC project areas. They are documented to occur more than 15 miles to the southwest, outside of the Columbia River Basin watershed.
Bull Trout	Salvelinus confluentus	LT, CH	Threatened	Special Status	Mountain streams, rivers, lakes	Bull trout have been identified recently and historically in Warm Springs Creek. A relatively healthy population exists above Meyers Dam.
Westslope Cutthroat Trout	Oncorhynchus clarkii lewisi		Sensitive	Sensitive	Mountain streams, rivers, lakes	Westslope cutthroat are found in Warm Springs Creek in the vicinity of both project areas.
Yellowstone Cutthroat Trout	Oncorhynchus clarkii bouvieri		Sensitive	Sensitive	Mountain streams, rivers, lakes	Not expected in WSC project areas. They are documented to occur more than 20 miles to the southwest, outside of the Columbia River Basin watershed.
Invertebrate						
Common Name	**Scientific Name**	**USFWS**	**USFS**	**BLM**	**Preferred Habitat**	**Notes**
Western Pearlshell	Margaritifera falcata		Sensitive		Mountain streams, rivers	Not expected in WSC project areas. They are documented to occur more than 10 miles to the southwest, outside of the Columbia River Basin watershed.
Mammals						
Common Name	**Scientific Name**	**USFWS**	**USFS**	**BLM**	**Preferred Habitat**	**Notes**
Fisher	Martes pennanti		Sensitive	Sensitive	Mixed conifer forests	Mixed conifer forest habitat does not occur in the vicinity of the project areas, therefore fishers are not expected. The closest occurrence is over 3 miles to the west of the project areas.
Fringed Myotis	Myotis thysanodes			Sensitive	Riparian and dry mixed conifer forests	Mixed conifer forest habitat does not occur in the vicinity of the project areas; therefore fringed myotis are not expected. The closest occurrence is over 20 miles to the southwest of the project areas.
Pygmy Rabbit	Brachylagus idahoensis		Sensitive	Sensitive	Sagebrush	Pygmy rabbits are not expected near the project areas. The closest occurrence of this species is over 25 miles to the southwest.
Wolverine	Gulo gulo luscus	C	Sensitive	Sensitive	Boreal Forest and Alpine Habitats	Not expected in WSC project areas due to the lack of boreal forest and alpine habitats. They are documented to the west and east of the project areas, with the closest areas to the west, over 5 miles away.

C = Candidate / LT = Listed Threatened / CH = Designated Critical Habitat DM = Recovered, delisted, and being monitored - Any previously listed species that is now recovered, has been delisted, and is being monitored.
BGEPA = The Bald and Golden Eagle Protection Act of 1940 (BGEPA) MBTA = The Migratory Bird Treaty Act (MBTA)
BCC = Birds of Conservation Concern 2008

3.1.2 Plants

The MNHP also documents 22 plant species of concern for Deer Lodge County. Of these, eight species have federal designations from either USFS or BLM and are listed in **Table 3-2**.

None of the MNHP plant species of concern are listed federally by the USFWS. However, USFWS does mention one additional plant (i.e., whitebark pine) in its 2012 letter as a candidate species for Deer Lodge County (USFWS 2010).

Of the nine total species listed in **Table 3-2**, seven are listed as sensitive with the USFS (i.e., alpine meadowrue, dense-leaved pussytoes, Lemhi beardtongue, mealy Primrose, storm saxifrage, weber's saw-wort, and whitebark pine) and five are listed as sensitive with the BLM (i.e., alpine meadowrue, annual indian paintbrush, Lemhi beardtongue, mealy primrose, and railroad canyon wild buckwheat) (MNHP 2013). A figure depicting locations where plant species of concern have been identified in relation to the project site can be found as **Figure A-5 in Attachment A.**

3.1.3 Species Potentially Impacted from Proposed Action

The USFWS, in their 2012 letter, indicated it did not expect any potential project impacts to the wolverine or whitebark pine. Other than bull trout, golden eagle, and bald eagle, no other plants or animals were mentioned specifically as a concern by the USFWS (USFWS 2012a). Below is a discussion of the likelihood that the golden eagle, bald eagle, and plants and animals that have been included in **Tables 3-1 and 3-2,** use habitats within the Section 32 and Lower Warm Springs Creek project areas**.** An overview on the bull trout can be found in Section 3.2, and a detailed discussion on the Warm Springs Creek bull trout population is provided in Section 3.3.2.

3.1.3.1 Animals (19 species)

In **Table 3-1**, there are a total of 19 animal species with federal designations. Of these, twelve species are not known to exist within the project area, as the closest confirmed MNHP occurrence is at least 5 miles away [i.e., western toad (over 20 miles away), greater sage grouse (over 25 miles away), Brewer's sparrow (over 20 miles away), great gray owl (over 20 miles away), northern goshawk (over 15 miles away), peregrine falcon (over 6 miles away), Arctic grayling (over 15 miles away), Yellowstone cutthroat trout (over 20 miles away), western pearlshell (over 10 miles away), fringed myotis (over 20 miles away), pygmy rabbit (over 25 miles away), and wolverine (over 5 miles away)]. The fisher is also not expected with a closest occurrence more than 3 miles to the west of the project areas. Furthermore, most of these species are not expected to be present because they require habitats that do not occur within the project areas. For others the project areas are simply not within the range of the animal. Some of the unexpected species discussed above may come near the project areas from time to time, however they not are expected to spend a majority of their time in or near the project area.

Eagle activity near the project areas has been documented for both the golden eagle (over 15 miles away) and the bald eagle (over 1 mile away). Breeding and non-breeding bald eagle activity is primarily concentrated along the Clark Fork River (USFWS 2012a). However, eagles are very mobile birds and may forage over a large area of land during certain times of the year. Golden eagles would be expected to occasionally forage in the vicinity of the project areas, but would not be expected to frequent areas targeted for remediation because the areas are not exclusively made up of their preferred habitat (i.e., open country, canyonlands, bluffs, etc.). Bald eagles may also forage in the area due to the presence of some deeper pools where fish congregate. Potential nesting habitat within the project areas is present in the form of large cottonwoods along the creek.

The project areas may provide habitat for three other species of concern listed in **Table 3-1**. These are black-crowned night heron (wetland habitats), long-billed curlew (grassland habitat), and westslope cutthroat trout (cold water stream habitat). The night-heron and long-billed curlew have been found to occur within one mile of the Lower Warm Springs Creek Project Area. Westslope cutthroat trout are found in Warm Springs Creek in the vicinity of both project areas (MNHP 2013).

3.1.3.2 Plants (9 species)

Within **Table 3-2**, there are a total of 9 plant species with federal designations. Of these, five species are not known to exist within the project area, as the closest confirmed MNHP occurrence is at least 10 miles away [i.e., dense-leaved pussytoes (over 15 miles away), Lemhi beardtongue (over 20 miles away), railroad canyon wild buckwheat (over 20 miles away), storm saxifrage (over 10 miles away), Weber's saw-wort (over 15 miles away), and whitebark pine (over 10 miles away). Additionally, preferred habitat for these species does not occur within the project areas.

Four designated plant species occur in the montane valley and riparian habitats present in the Warm Springs Creek project areas. Three of these designated plant species are known to occur within one mile of the Lower Warm Springs Creek Project Area. These are alpine meadowrue (wetland/riparian habitat), annual Indian paintbrush (wetland/riparian habitat), and Mealy primrose (wetland/riparian habitat). The meadowrue and primrose are listed as "sensitive" with the USFS and BLM, while the paintbrush is listed as "sensitive" with only BLM. However, these plant species are not listed by the USFWS and are not protected by state or federal statutes; therefore, the impact of proposed remedial actions on these three plant species was not evaluated.

Table 3-2 Plant Species with Federal Designations – Deer Lodge County, MT

Plants						
Common Name	**Scientific Name**	**USFWS**	**USFS**	**BLM**	**Preferred Habitat**	**Notes**
Alpine Meadowrue	Thalictrum alpinum		Sensitive	Sensitive	Wetland/Riparian	Five occurrences in or near Deer Lodge County, The closest two occurrences are within 1 mile of the Lower Warm Springs Creek (WSC) project area. The other three occurrences are over 15 miles to the west.
Annual Indian Paintbrush	Castilleja exilis			Sensitive	Wetland/Riparian	Five occurrences in or near Deer Lodge County. The closest occurrence is within 1 mile of the lower WSC project area. All occurrences located to the northeast of WSC project areas.
Dense-leaved Pussytoes	Antennaria densifolia		Sensitive		Alpine	Not expected in WSC project areas. There is only one occurrence in or near Deer Lodge County. This occurrence is over 15 miles to the southwest.
Lemhi Beardtongue	Penstemon lemhiensis		Sensitive	Sensitive	Sagebrush-grasslands	Lemhi beardtongue is not expected near the project areas. The closest occurrence of this species is over 20 miles to the southwest.
Mealy Primrose	Primula incana		Sensitive	Sensitive	Wetland/Riparian	Habitat exists on the project sites for mealy primrose. Six occurrences are within 1 mile of the Lower WSC project area.
Railroad Canyon Wild Buckwheat	Eriogonum soliceps			Sensitive	Ridges/slopes (Open, Montane)	Not expected in WSC project areas. The only occurrence is more than 20 miles to the southwest, outside of the Columbia River Basin watershed.
Storm Saxifrage	Micranthes tempestiva		Sensitive		Alpine	Not expected in WSC project areas. Seven occurrences in or near Deer Lodge County, with all to the west and southwest of project areas. The closest occurrence is over 10 miles to the west.
Weber's Saw-wort	Saussurea weberi		Sensitive		Alpine	Not expected in WSC project areas. There is only one occurrence in or near Deer Lodge County. This occurrence is over 15 miles to the southwest.
Whitebark Pine	Pinus albicaulis	C	Sensitive		Subalpine forest, timberline	Not expected in WSC project areas. No subalpine forest habitat exists in either project area. The closest occurrence is over 10 miles to the west.

C = Candidate / LT = Listed Threatened / CH = Designated Critical Habitat
DM = Recovered, delisted, and being monitored - Any previously listed species that is now recovered, has been delisted, and is being monitored.
BGEPA = The Bald and Golden Eagle Protection Act of 1940 (BGEPA)
MBTA = The Migratory Bird Treaty Act (MBTA)
BCC = Birds of Conservation Concern 2008

3.2 Bull Trout Overview

3.2.1 Description

Bull trout are members of the char subgroup of the salmon family, which also includes the Dolly Varden, lake trout, and Arctic char. Bull trout and Dolly Varden (*Salvelinus malma girard*) were both formally known as Dolly Varden (*Salvelinus malma walbaum*). Taxonomic work published in 1978 and accepted by the American Fisheries Society in 1980, identified bull trout as distinct from the Dolly Varden. Compared to Dolly Varden, bull trout are larger on average, with a relatively longer and broader head. In addition, Dolly Varden trout are more common in coastal areas, whereas bull trout are considered mainly an inland species (USFWS 1998b).

Genetic studies in 2003 by Costello et al., suggest that the bull trout comprises two or more clades that originated from distinct glacial refugia on either side of the Cascade/Coast Mountains. Genetic data also indicate that local populations of bull trout likely have high levels of demographic independence, and exhibit low levels of intrapopulation variation (NatureServe 2011). Therefore, each subpopulation of bull trout is important to maintaining maximum genetic variability, and re-colonization of extirpated populations from neighboring watersheds may not be sufficient to maintain the species' genetic diversity.

Bull trout have an elongated body that is somewhat rounded and slightly compressed laterally, and covered with cycloid scales numbering190-240 along the lateral line (Brown 1971). The mouth is large with the maxilla extending beyond the eye. Well-developed teeth are present on both jaws and the head of the vomer (none on the shaft). Bull trout have 11 dorsal fin rays, 9 anal fins, and the caudal fin is slightly forked. Although they are often olive green to brown with paler sides, color is variable with locality and habitat. Their spotting pattern is easily recognizable showing pale yellow spots on the back, and pale yellow and orange or red spots on the sides. Bull trout fins are tinged with yellow or orange, while the pelvic, pectoral, and anal fins have white margins. Black markings are absent on the fins (USFWS 1998a; NPS 2011). Spawning adults develop varying amounts of red on the belly (USFWS 1998b), and spawning males often develop a pronounced hook, or kype, on the lower jaw (Hammond 2004).

Sexual dimorphism exists in bull trout and male fish are often larger than females (Hammond 2004). Bull trout can grow to more than 20 pounds in lake environments, but individuals that live in streams rarely exceed 4 pounds (USFWS 1998b).

3.2.2 Distribution

Char, including bull trout, are one of the northernmost distributed of all freshwater fish, and are very well adapted for life in cold water. The occurrence of bull trout is strongly associated with elevation and thermal gradients in streams. Historically, bull trout occurred throughout the Columbia River Basin (USFWS 1998b). Today, bull trout are found primarily in upper tributary streams and several lake and river systems; they have been eliminated from the main stems of most large rivers. Through the years, the distribution of bull trout has diminished throughout its range, with most of this reduction occurring at its southern fringe. The main populations remaining in the lower 48 states are in Montana, Idaho, Oregon, and Washington (**Figure 3-1**) (MTNHP & Montana FWP 2012). Bull trout are now extinct in California and only a small population still exists in the headwaters of the Jarbidge River in Nevada, which represents the present southern limit of the species' range. Bull trout are known or predicted to occur in 45 percent of the watersheds within the historical range and to be

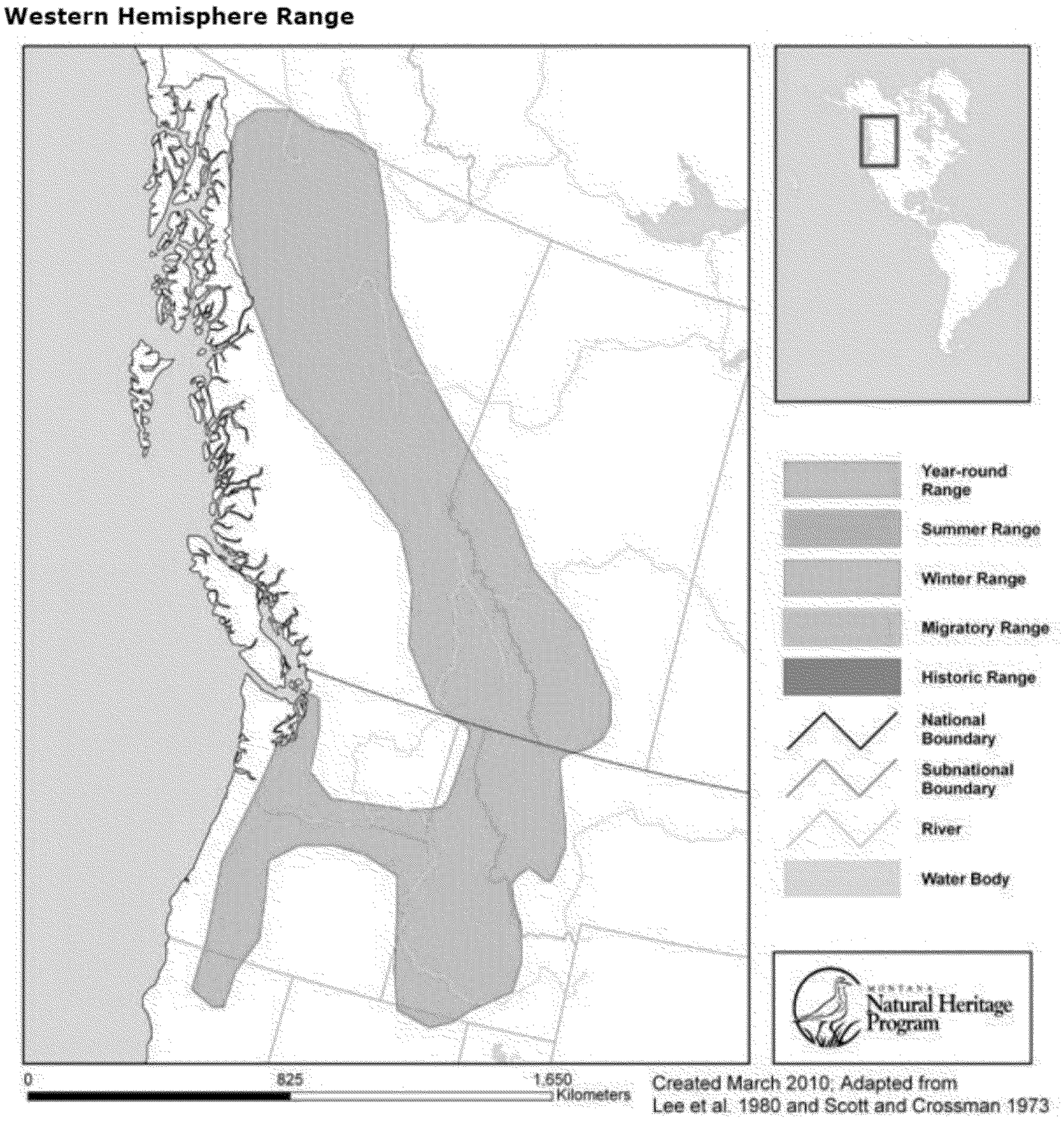

Figure 3-1 - Current distribution of bull trout (MTNHP & Montana NWP 2012)

absent in 55 percent (USFWS 1998a; NPS 2011). The Columbia River population segment, which includes subpopulations in the Warm Springs Creek watershed, comprises approximately 386 populations of bull trout. The long-term trend of the Columbia River population segment reveals that 33% of populations are declining, 15% are stable, 3% are secure, and 47% have unknown status (NatureServe 2011).

In 1995, the USFWS found that listing bull trout throughout its range was not warranted due to unavailable or insufficient data regarding threats to and status and populations trends of the species in Alaska and Canada. However, USFWS found that listing the species within the coterminous United States was warranted, but was precluded by other higher priority listing actions. In 1998, USFWS listed the Klamath River population segment and the Columbia River population segment as "threatened". In 1999, the bull trout was listed threatened throughout its entire range in the coterminous United States, when the Jarbidge River, coastal-Puget Sound, and St. Mary-Belly River segments were listed as threatened (NatureServe 2011).

On September 30, 2010, USFWS designated critical habitat for bull trout throughout their U.S. range. Approximately 18,795 miles of streams and 488,252 acres of lakes and reservoirs in Idaho, Oregon, Washington, Montana, and Nevada were designated (**Figure 3-2**). The designation is intended to provide sufficient habitat to allow for genetic and life history diversity, ensure bull trout are well distributed across representative habitats, ensure sufficient connectivity among populations, and allow for the ability to address threats facing the species (USFWS 2010).

In Montana, bull trout were once common in most of the larger affluents of the Columbia River including the Clark Fork River above and below Missoula and the Flathead River above and below Flathead Lake, as well as the Bitterroot and Blackfoot Rivers. However, mining and ore-processing operations in the Butte and Anaconda areas probably eliminated bull trout from the mainstem and portions of the headwaters of the Upper Clark Fork River prior to the turn of the 20th century.

At present, within the state of Montana, the bull trout occupies the Clark Fork and Flathead drainages. In the Upper Clark Fork drainage, population trends have been slowly declining and the present distribution is much reduced from historic levels. Today, bull trout are very rare in the mainstem of the Upper Clark Fork River above Flint Creek, and the species is primarily isolated in the upper reaches of the Warm Springs Creek drainage (Montana FWP 2012). The migratory bull trout life form in the Upper Clark Fork River above the former Milltown Dam has largely disappeared. At present, bull trout populations in the Upper Clark Fork River drainage, except for Rock Creek, are composed of small-sized, resident fish inhabiting tributary streams. These populations are isolated from one another due to human activities resulting in unsuitable habitat and physical barriers to fish movement (MBTSG 1995). The migratory bull trout life form does persist in the Rock Creek drainage and could be a source population if habitat conditions in other streams improve.

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Figure 3-2. Designated Critical Habitat for Bull Trout in the Columbia River Basin

Warm Springs Creek Biological Assessment - Anaconda, MT

When designating critical habitat for bull trout in 2010, USFWS used relevant factors under two of the criteria in its 1996 Distinct Population Segment policy to identify six Recovery Units (RUs) for distinct populations of bull trout. USFWS also identified 32 Critical Habitat Units (CHUs) and 78 Critical Habitat Subunits (CHSUs) within the six RUs throughout the range of bull trout based on distribution, connectivity, and proximity among populations. It was determined that individually each of the 32 CHUs and 78 CHSUs are essential for the conservation of the species (USFWS 2010). Populations of bull trout within the Warm Springs Creek watershed fall within the Columbia Headwaters RU, Clark Fork Basin CHU, and Upper Clark Fork River CHSU. The location of all designated bull trout critical habitat in southwestern Montana is provided in **Figure 3-3**.

3.2.3 Life History Characteristics

3.2.3.1 Reproduction and Development

Bull trout spawn from August through November during periods of decreasing water temperatures. However, migratory bull trout frequently begin spawning migrations in early summer (Fraley and Shepard 1989). Spawning may occur each year or in alternate years, and occurs in the upper reaches of clear streams in areas of flat gradient, uniform flow, and uniform gravel or small cobble (NatureServe 2011). Females select redd sites and excavate the nest. Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Rieman and McIntyre 1996). Courtship and spawning are carried out at the redd and a complete round of spawning often requires several days. Fecundity of females is proportional to body size; small, resident females may produce 500 eggs, while much larger, migratory fish will produce 2,000-5,000 eggs (Hammond 2004). First spawning is often noted after age four, with individuals living 10 or more years (Rieman and McIntyre 1993).

Existing studies suggest that successful incubation of bull trout embryos requires cold water temperatures, a gravel/cobble substrate with high permeability to allow water to flow over incubating eggs, and low levels of fine sediment [i.e., particles smaller than 6.35 millimeters (0.25 inches) in diameter] that smother eggs and fry. Eggs are deposited as deep as 25 centimeters (10 inches) below the streambed surface (MTNHP & Montana FWP 2012). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992). Hatching may occur in winter or early spring, but alevins (i.e., young fish) may stay in the gravel for an extended period after yolk absorption (McPhail and Murray 1979). Fry and juvenile fish are strongly associated with the stream bottom and are often found at or near it. Juvenile fish from migratory populations migrate from their natal areas during their third or fourth summer (Hammond 2004).

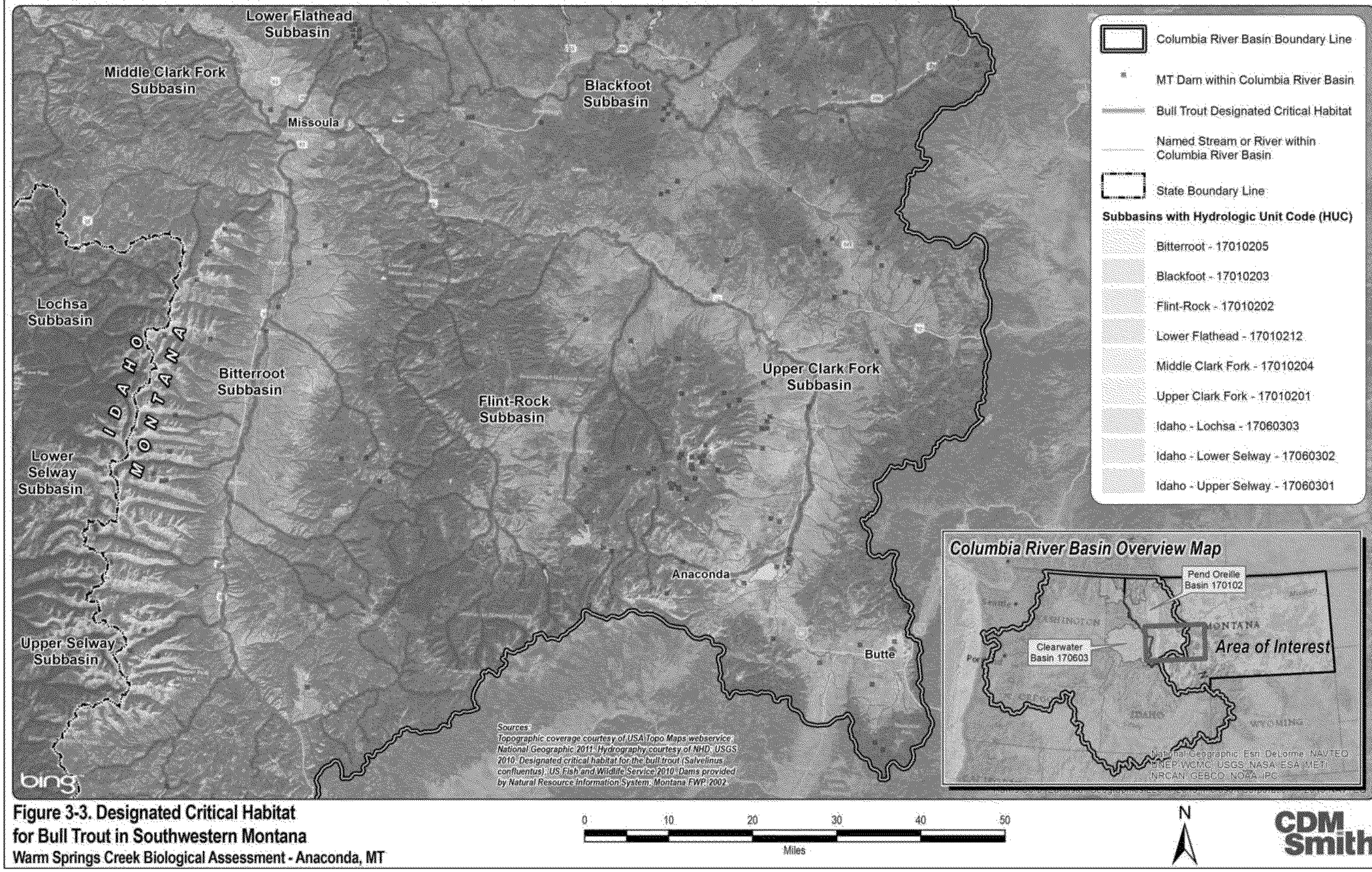


Figure 3-3. Designated Critical Habitat for Bull Trout in Southwestern Montana
Warm Springs Creek Biological Assessment - Anaconda, MT

Growth, maturation, and longevity vary depending upon life-history strategy and environment. Two distinct life-history forms, migratory and resident, have been recorded for bull trout (Pratt 1992; Rieman and McIntyre 1993). Migratory forms rear in natal tributaries before moving to larger rivers (fluvial form), lakes (adfluvial form), or the ocean (anadromous) to mature. Migratory bull trout may use a wide range of habitats ranging from 2nd to 6th order streams which vary by season and life stage. Seasonal movements may range up to 300 km as migratory fish move from spawning and rearing areas into overwinter habitat in downstream reaches of large basins (Bjornn and Mallet 1964, Elle et al. 1994). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. Resident and migratory forms are believed to exist together in some areas, but migratory fish may dominate populations where corridors and subadult rearing areas are in good condition (Rieman and McIntyre 1993). Growth of resident fish is generally slower than migratory fish; resident fish tend to be smaller at maturity and less fecund (Fraley and Shepard 1989; Goetz 1989). Resident adults range from 6-12 inches total length, while migratory adults commonly reach 24 inches or more (Goetz 1989).

3.2.3.2 Diet and Feeding Behaviors

Bull trout fry feed on aquatic insects near or on the bottom of the stream. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macroplankton, amphipods, mysids, crayfish, and small fish (Rieman and McIntyre 1993; Goetz 1989). Juveniles in the Flathead Basin in Montana are benthic and drift foragers that feed predominantly on dipterans and ephemeropterans (Hammond 2004). Adult migratory bull trout and resident trout 110 mm or longer are apex predators that are primarily piscivorous, known to feed on various trout (*Salmo* sp.), salmon (*Onchorynchus* sp.), whitefish (*Prosopium* sp.), yellow perch (*Perca flavescens*), and sculpin (*Cottus* sp.) (Fraley and Shepard 1989; Donald and Alger 1993). Bull trout are primarily ambush predators and are highly dependent on cover, usually in the form of deep pools, large woody debris, and undercut banks (Hammond 2004).

3.2.4 Habitat Requirements

Bull trout tend to have more specific habitat requirements than other salmonids (Reiman and McIntyre 1993). Habitat characteristics including water temperature, stream size, substrate composition, cover, and hydraulic complexity have been associated with their distribution and abundance (Dambacher et al. 1992; Jakober 1995; Reiman and McIntyre 1993).

Four elements relate to suitable bull trout habitat, known as the "Four Cs": 1) Clean substrate composition that includes free interstitial spaces; 2) complex cover including large woody debris, undercut banks, boulders, shade, pools, or deep water; 3) cold water temperatures; and 4) connected habitats through migratory corridors (USFWS 2013b). Spawning bull trout require hiding cover such as logs and undercut banks. Strong populations require high stream channel complexity, and are likely to be found in areas with low road densities, forested land use, and in mid-size streams at relatively high elevations [i.e., 5,000 feet above mean sea level (MSL)] (Quigley and Arbeldide 1997). These strict habitat requirements make spawning and incubation habitat for bull trout limited and valuable.

In a 2003 study evaluating the association of local habitat features, large-scale watershed factors, the presence of brook trout, and connectivity to neighboring bull trout populations on the occurrence of bull trout in the Bitterroot River drainage in western Montana, it was determined that bull trout occurrence is positively associated with channel width, large woody debris, and the presence of strong neighboring bull trout populations. Bull trout occurrence is negatively associated with high channel gradient and the presence of brook trout. In addition, models based on elevation, basin area, tributary slope, and local habitat or biotic variables alone were poor predictors of bull trout occurrence. Therefore, in western Montana, bull trout have increased resistance to invasion by brook trout in streams with high habitat complexity and connectivity (Rich Jr et al. 2003).

A 1997 study (Watson and Hillman) describing the relationship between distribution and abundance of bull trout and physical and biotic factors across a large portion of their historical range had similar conclusions as the 2003 study, and found that bull trout occurred significantly more often in sites within alleviated lowlands and valleys with:

- Undercut banks
- Large substrates
- Frequent deep pools
- High in-stream gradient complexity
- High percentages of boulder and wood cover
- Riparian vegetation dominated by trees and shrubs

Bull trout occurred significantly less often in sites with:

- Fine substrates
- Extensive canopy cover and vegetation overhang
- Presence of brook trout

Stream temperatures and substrate composition may be particularly important characteristics of suitable habitats. Bull trout have repeatedly been associated with the coldest stream reaches within basins. Preferred bull trout spawning habitat consists of low gradient streams with loose, clean gravel (Fraley and Shepard 1989) and water temperatures from 5° to 9°C (Goetz 1989). Goetz (1994) did not find juvenile bull trout in water temperatures around 12.0°C. The best bull trout habitat in several Oregon streams was where water temperature seldom exceeded 15°C (Buckman et al. 1992; Ratliff 1992; Ziller 1992). Temperature also appears to be a critical factor in the spawning and early life history of bull trout. Bull trout in Montana spawn when temperatures dropped below 9 to 10°C (Fraley and Shepherd 1989). McPhail and Murray (1979) reported 9°C as the threshold temperature to initiate spawning. Temperatures fell below 9°C before spawning began in the Metolius River, Oregon (Reihle 1993). Survival of bull trout eggs varies with water temperature. McPhail and Murray (1979) reported that 0-20%, 60-90%, and 80-95% of the bull trout eggs from British Columbia survived hatching in water temperatures of 8-10°C, 6°C, and 2-4°C, respectively. Weaver and White (1985) found that 4-6°C was needed for egg development for Montana bull trout. Temperature may be strongly influenced by land management and climate change, both of which may play an important role in the persistence of bull trout (Henjum et al. 1994).

Bull trout are more strongly tied to the stream bottom and substrate than other salmonids (Pratt 1992). Substrate composition has repeatedly been correlated with the occurrence and abundance of juvenile bull trout (Dambacher et al. 1992; Rieman and McIntyre 1993) and spawning site selection by adults (Graham et al. 1981; McPhail and Murray 1979). Spawning sites are characterized by low gradients (1.0-1.5 %), clean gravel < 20 mm, water velocities of 0.03-0.80 m/s, and cover in the form of undercut banks, debris jams, pools, and overhanging vegetation (Hammond 2004). Fine sediments can influence incubation survival and emergence success (Weaver and White 1985), while also limiting access to substrate interstices that are important cover during rearing and overwintering (Goetz 1994; Jakober 1995).

Bull trout at different stages of development have channel morphology and flow velocity preferences. Bull trout fry are often associated with shallow water, low-velocity side channels, and abundant in-stream cover in the form of cobble and boulders. In-stream cover is also important to juvenile bull trout, which prefer pools over riffles, runs, or pocket water (Hammond 2004). Older individuals are most often found in deeper and faster water compared to juveniles. Adults are often found in pools sheltered by large, organic debris or clean, cobble substrate (McPhail and Murray 1979). In intermountain areas, lower-elevation lakes and rivers constitute important habitats for maturing and overwintering fluvial and adfluvial bull trout. Stream resident bull trout tend to occupy small, high-elevation streams. For all bull trout, persistent populations require the presence of suitable corridors for movement between winter and summer habitats and for genetic exchange among populations (NatureServe 2011).

Forest health and the maintenance of riparian forests are very important for maintaining the integrity of bull trout habitat. The forest structural stage surrounding streams may play an important role. Generally, mature forests contribute more large woody debris, sediment and pollutant trapping and storage, nutrient cycling, and fish habitat structure than young forests (Hammond 2004). Mature forests also provide more stream shading, which can lead to lower water temperatures favored by bull trout.

Stream-resident populations of bull trout require suitable ice-free overwintering sites. In the fall, fish will move from small tributaries into larger streams or rivers. Overwintering habitat requirements are low-velocity water with sufficient depth to provide ice-free refuges and overhead and in-stream cover. Adults often undergo extensive downstream migrations to overwintering habitat (Hammond 2004).

3.2.5 Key Survivability Factors

Due to their life history requirements, bull trout are more sensitive than many other salmonids to changes in water temperature, water quality, and flow conditions. Historical and on-going land management activities have degraded stream habitat, particularly along larger river systems and stream areas located in valley bottoms, to the point where bull trout can no longer survive or reproduce successfully. Bull trout are also threatened by activities that damage riparian areas and cause siltation including logging, road construction, mining, and overgrazing (Rieman and McIntyre 1993). In many watersheds, remaining bull trout are small, resident fish isolated in headwater streams (USFWS 1998b).

Watershed disruption is a factor that has played a role in the decline of bull trout. In Montana, disruption of a watershed is often associated with increased development (e.g., forest harvest, grazing, resource mining, and urban development). Changes in or disruptions of watershed processes likely to influence characteristics of stream channels are also likely to influence the dynamics and persistence of bull trout populations. Bull trout have been more strongly associated with pristine or only lightly disturbed basins (Brown 1992; Clancy 1993; Cross and Everest 1995; Dambacher et al. 1992; Huntington 1995; Ratliff and Howell 1992).

Conditions that favor the persistence of populations include stable channels, relatively stable stream flow, low levels of fine substrate sediments, high stream channel complexity with various cover types, and temperatures not exceeding 15°C (NatureServe 2011). The eggs and young are particularly vulnerable to winter and early spring conditions such as low flows, which can strand eggs and embryos or lead to freezing within the substrate. These life stages are also susceptible to flooding and scouring. Success of embryo survival, fry emergence, and overwinter survival of juveniles is related to low sedimentation levels. Increased sediment leads to losses in pool depth and frequency, reductions in interstitial spaces, channel braiding, and potential instabilities in the supply and temperature of groundwater inputs. Fine sediment can also cause direct injury to fish by impairing feeding ability through increased turbidity, reducing food availability through smothering, and clogging and abrading fish gills (Hammond 2004).

Mid-summer dewatering in the Upper Clark Fork basin also affects habitat quality for bull trout. Irrigation withdrawal can have significant impacts on stream flows in the river upstream of Deer Lodge, especially during drought years. Low flows increase water temperatures to levels that make habitat unsuitable for trout, and extensive aquatic plant and algal growth affect dissolved oxygen levels (Montana FWP 2012).

Introduced species are another factor influencing bull trout. More than 30 introduced fish species occur within the present distribution of bull trout. Species such as brown, brook, and lake trout are thought to have depressed or replaced bull trout populations (Dambacher et al. 1992; Donald and Alger 1992; Howell and Buchanan 1992; Kanda et al. 1997; Leary et al. 1993, Ratliff and Howell 1992). Brook trout are seen as an especially important problem (Kanda et al. 1997; Leary et al. 1993) and may progressively replace bull trout through hybridization and higher reproductive potential (Leary et al. 1993). Replacement occurs because hybridization reduces the quantity of pure bull trout genetic stock and brook trout tend to reproduce earlier and at a higher rate than bull trout. In addition, because hybridization in western Montana generally involves female bull trout and male brook trout, it represents greater wasted reproductive effort for bull trout (NatureServe 2011). Brook trout now occur in the majority of the watersheds representing the current range of bull trout. While not as widely documented, hybridization with brown trout and lake trout is a problem in some areas (USFWS 1998b).

In addition to hybridization, introduced species have been associated with bull trout declines due to competitive interactions. Brown trout, rainbow trout, and residual steelhead have been linked to bull trout population decreases due to competition for food, shelter, and spawning habitat. In addition to competitive interactions, lake trout may have a negative impact on bull trout due to predation on juveniles and increased harvest associated with increased fishing pressure for lake trout (NatureServe 2011). Introduced species may pose greater risks to native species where habitat disturbance has occurred (Hobbs and Huenneke 1992).

Much can be learned from the relatively recent extirpation of bull trout from the McCloud River in California. Minckley and Deacon (1991) concluded that the loss of this population probably resulted from two factors: 1) interaction with the introduced brown trout, and 2) indirect effects resulting from the loss of the river's spawning population of Chinook salmon, including the loss of nutrients provided by dying salmon which altered the character of the stream (NatureServe 2011).

Isolation and fragmentation are other factors likely to influence the status of bull trout. Historically bull trout populations were well connected throughout the Columbia River Basin (USFWS 2013b). Habitat available to bull trout has been fragmented, and in many cases populations have been isolated entirely. Dams have isolated whole subbasins throughout the Basin, thereby preventing the exchange of genetic material across populations (see for example Brown 1992; Kanda et al. 1997; Pratt and Huston 1993; Rieman and McIntyre 1995). Irrigation diversions, culverts, and degraded main stem habitats have eliminated or seriously depressed migratory life histories effectively isolating resident populations in headwater tributaries (Brown 1992; Ratliff and Howell 1992; Rieman and McIntyre 1993). In addition to physically blocking migration routes, in-stream structures alter water temperatures, flow regimes, and directly kill fish as they pass through and over dams, or are trapped in irrigation and other diversion structures (USFWS 1998a). Loss of suitable habitat through watershed disturbance may also increase the distance between good or refuge habitats and strong populations; thus, reducing the likelihood of effective dispersal and re-colonization following catastrophic events (Frissell et al. 1993).

Fragmentation and isolation also has an impact on the genetic health of bull trout. A reduction in genetic diversity can lead to a loss of fitness due to effects of inbreeding. Effective population size is an important concept in the management of threatened species like bull trout, and refers to the number of breeding individuals needed to prevent a loss of genetic diversity. In a 2001 study, it was estimated that the effective population size for bull trout is 0.5 to 1.0 times the mean number of adults spawning annually. Therefore, a cautious long-term management goal for bull trout populations should include an average of at least 1,000 adults spawning each year. Where local populations are too small, managers should seek to conserve a collection of interconnected populations large enough in total to meet this minimum to provide for full expression of life history variation and the natural processes of dispersal and gene flow (Rieman and Allendorf 2001).

Climate change is a potential threat because it would decrease the amount of suitable habitat due to potential increased water temperatures. Bull trout may be particularly vulnerable to climate change given that spawning and early rearing are constrained by cold water temperatures. A reduction in the size and connectivity of suitable habitats for all life stages could increase the effects of fragmentation and accelerate the decline of the species.

3.3 Warm Springs Creek and Tributaries

3.3.1 Watershed and Project Area Characteristics

Warm Springs Creek is a fourth order tributary of the Clark Fork River with a drainage area of approximately 164 square miles (CDM 1999). Warm Springs Creek is a perennial stream with its headwaters located at high elevations in the Anaconda and Pintlar mountain ranges to the west of the project areas (**Figure 3-4**). The watershed is located in the Northern Rocky Mountains physiographic province characterized by rugged mountains and intermontane valleys (NPS 2007). The high point of the watershed is Mount Evans at 10,635 feet MSL. The lowest point, at the confluence with the Clark Fork River, is 4,779 feet (MSL). Average annual precipitation ranges from 50 inches in the headwaters to 12 inches at the confluence with the Clark Fork River. A majority of the precipitation falls as snow in the mountains (CDM 1999). Primary groundwater inputs originate from the alluvial aquifer that lies below the Deer Lodge Valley. The depth of aquifer ranges from a few feet at valley edges to several hundred feet at the center of the valley (Montana FWP 2006). In areas where the water table is shallow, wetlands and willow flats are often present within the floodplain.

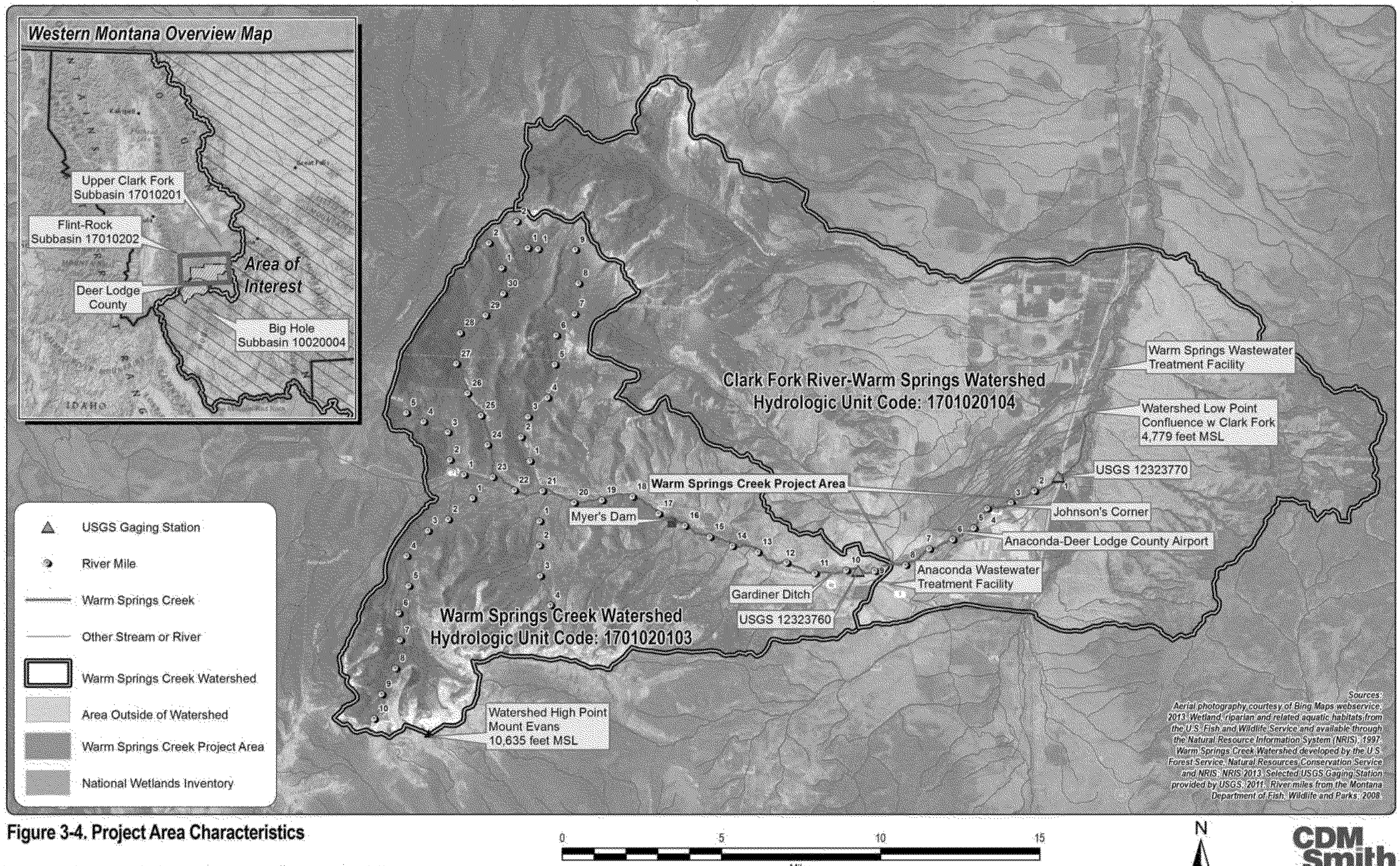


Figure 3-4. Project Area Characteristics

Warm Springs Creek Biological Assessment - Anaconda, MT

CDM Smith

The lower reaches of Warm Springs Creek are generally bounded by the upstream U.S. Geological Survey (USGS) gaging station 12323760 (Warm Springs Creek near Anaconda) and the downstream station 12323770 (Warm Springs Creek at Warm Springs) **(Figure 3-4).** This coincides with the area of interest—Warm Springs Creek downstream of Anaconda. Land use in this area includes agriculture, grazing, open space–wildlife habitat, and recreational uses such as hunting **(Figure 3-5).** The area ranges from a dry, upland setting to the west near Galen Road that transitions to sub-irrigated wet meadow near the Anaconda-Deer Lodge County Airport (CDM Smith 2012).

Warm Springs Creek conforms to similar seasonal patterns of southwest Montana waterways, with peak flows occurring in May and June from snowmelt runoff. Ice jams are common along the creek during the winter months and may cause flooding. Low flows occur from July through September when water is diverted for irrigation (CDM Smith 2012).

One major diversion is present at Gardiner Ditch near the upstream USGS station, with another located at the Montana FWP ditch near Warm Springs. Several smaller diversions exist in the lower reaches of Warm Springs Creek, but few are in operation (CDM Smith 2012). Water may only be diverted into Gardiner Ditch when there is 40 cfs at the upstream USGS gaging station and there is 40 cfs at the downstream USGS gage near Warm Springs. The upper gage determines the water that is available and the lower gage controls when water must be left in the stream. In dry years, including the irrigation seasons of 1998-2002, the stretch between Gardiner Ditch and the confluence with the upper Clark Fork River is frequently dewatered by water diversions (Montana FWP 2006). USGS gage data indicate that in a typical year, 20-30 percent of total discharge is lost in this portion of Warm Springs Creek, primarily to irrigation. Additional volume is lost to side channels, where water ponds and infiltrates or evaporates. Despite the surface water losses, groundwater inputs east of the Anaconda-Bowman Field airport and recent in-stream flow agreements have led to fairly good summer base flows throughout the lower reaches of Warm Springs Creek (Montana FWP 2010).

Due to historic metals ore processing and smelting, large quantities of flood-deposited tailings are present throughout the valley surrounding Warm Springs Creek. These deposits were derived from exposed and easily eroded mine and smelter wastes and tailings, and are composed of a number of metals such as arsenic, cadmium, copper, iron, manganese, lead, and zinc (Smith et al. 1998). These contaminated deposits exist within the stream channel and the 100-year floodplain of Warm Springs Creek, and have the potential to impose chronic toxicity on the biota of the watershed. Metal bearing minerals are often altered by mining, weathering, and fluvial processes to become more bioavailable and some bioaccumulate up the human health and ecological food chains. These food chain effects interrupt natural cellular processes in the body resulting in a myriad of health problems, particularly concerning the nervous system (NPS 2007).

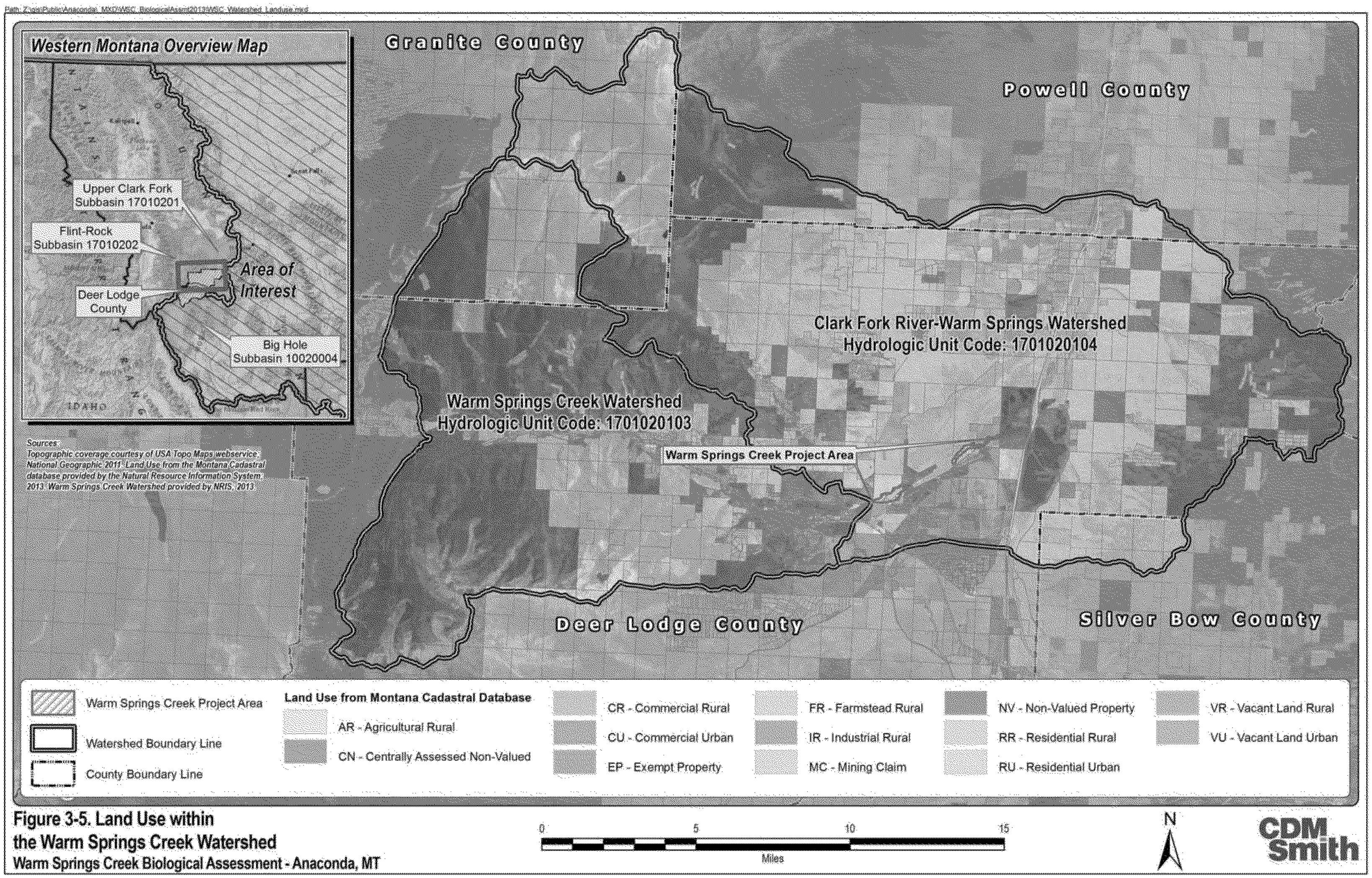


Figure 3-5. Land Use within the Warm Springs Creek Watershed
Warm Springs Creek Biological Assessment - Anaconda, MT

The Montana Water Quality Standard classification for Warm Springs Creek is B-1, indicating that its waters are to be "maintained suitable for drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply" (Montana FWP 2006). However, due to high levels of arsenic and other contaminants of concern, the lower reaches of Warm Springs Creek have failed to meet this standard (USEPA 2013b). Impaired water quality has also resulted from nutrient loading, sedimentation, flow alterations, channelization, and loss of woody riparian vegetation.

Water quality impairments have resulted in the listing of lower Warm Springs Creek from Warm Springs to Meyers Dam. A Total Maximum Daily Load (TMDL) document for this stream segment was prepared by the U.S. Environmental Protection Agency (USEPA) in 2010 for sediment, metals, and temperature. Total load allocations were established for arsenic, cadmium, copper, lead, and zinc (USEPA 2012). The 2012 USEPA Waterbody Report for Warm Springs Creek below Meyers Dam indicated that agricultural and industrial designated uses were met; however, designated uses for drinking water, primary contact recreation, and the protection and propagation of aquatic life and cold water fishes were impaired. Causes of impairment were identified and included flow alteration, substrate alteration, sedimentation/siltation, and a reduction in vegetative cover most likely caused by agricultural activities, especially irrigated crop production and grazing in riparian zones (USEPA 2013b).

Two wastewater treatment facilities exist within the drainage basin and are associated with the towns of Anaconda and Warm Springs. The Anaconda facility is located between the town and Galen Road, and the Warm Springs facility is located between the Clark Fork River and I-90 (**Figure 3-4**). Both facilities utilize treatment lagoons (CDM 1999).

Generally, Warm Springs Creek presents a concave profile with slope increasing as one moves upstream. Lowest slopes can be found near the confluence with the Clark Fork River. Channel straightening has changed the slope of the stream bed in several areas, and has caused downcutting, bank erosion, and stream bed aggradation downstream of the modified sections. Channelization is most evident within Anaconda, immediately downstream of Galen Road, and near Johnson's Corner (CDM Smith 2012). Bed material is generally a mixture of boulders, cobble, sand, and some silt with a preponderance of cobble. As can be expected, grain size tends to increase in the upstream direction. Fine bed material is present in greater amounts in reaches with multiple channels and in reaches with beaver activity. A silt, clay, cobble mixture is present in many of the cutbanks indicating that historically many more fines were carried by the stream than is presently the case (CDM 1999).

Overall, habitat quality and riparian condition in lower Warm Springs Creek is relatively good. However, several areas show impacts from past mining activity, urbanization, and livestock grazing in the riparian zone. Urbanization is largely restricted to areas within the communities of Anaconda, Warm Springs, and West Valley. Residential development has impacted the stream corridor largely through riparian clearing and bank stabilization efforts using riprap. The presence of mine waste deposits has affected riparian vegetation in some areas by stunting the growth of native vegetation and allowing less desirable and more tolerant species to become established. While livestock grazing is limited, in areas where cattle have access to the stream, impacts to streambank stability and riparian vegetation are evident (Montana FWP 2010).

Much of lower Warm Springs Creek flows through private lands used for residential or agricultural purposes. The nature of the ownership and land use poses some concerns for habitat security in much of the reach. However, the greatest threat to habitat security is the presence of mine wastes along the stream (Montana FWP 2010).

The lower reaches of Warm Springs Creek up to Meyers Dam are identified as a "Priority 1" according to the "Rating Summaries for the Prioritization of Tributaries of the Upper Clark Fork River Basin for Fishery Enhancement" document completed in 2010 (Montana FWP 2010). Priority 1 areas are protected, listed, or threatened streams that have a high potential for improvement of local fisheries through habitat restoration. Both the Lower Warm Springs Creek Project Area and the Section 32 Project Area are within this "Priority 1" area.

Brown trout, brook trout, and rainbow trout are the most common trout species in Warm Springs Creek. The lower reaches of Warm Springs Creek contain spawning habitat for Clark Fork River brown trout and are likely major sources of brown trout recruitment to the Clark Fork River. Warm Springs Creek also supports long nose sucker, large scale sucker, mountain whitefish, slimy sculpin, and redside shiner (Montana FWP 2006).

Warm Springs Creek also contains self-sustaining populations of bull trout and westslope cutthroat trout located primarily in the upper reaches above Meyers Dam. Bull trout are federally listed as threatened and westslope cutthroat trout are a state species of concern. The entire length of Warm Springs Creek from the confluence with the Clark Fork River upstream to and including Silver Lake is designated critical habitat for bull trout, and consultation with wildlife agencies is required for human activities that could impact the species. The Warm Springs Creek population of bull trout is discussed in further detail in Section 3.3.2.

3.3.1.1 Lower Warm Springs Creek Project Area

The Lower Warm Springs Creek Project Area is located within the lower reaches of Warm Springs Creek at approximately river mile (RM) 2.4 to RM 4.8 (**Figure 3-6**). Downstream of the project area, extensive channelization has occurred to separate the stream from the Warm Springs sewage lagoons and to achieve a perpendicular crossing of I-90 and associated access ramps. Channelized areas are well armored with angular riprap (CDM 1999). Despite alterations downstream, the Lower Warm Springs Creek Project Area has retained high sinuosity throughout with only a few exceptions. Beginning at the eastern Johnson Ranch property line, four small reaches have been straightened or armored to protect residences and agricultural interests from flooding and to redirect streamflow to irrigation headgates. The historic channel can still be identified in most of the channelized reaches. Although the channelized reaches themselves appear stable, upstream and downstream of each channelization are numerous cutbanks representing the stream's attempt to increase its sinuosity and reduce stream power (CDM 1999).

Historical contamination due to smelting operations has degraded water and sediment quality throughout the Lower Warm Springs Creek Project Area. Elevated levels of heavy metals, particularly copper, are observed during high flows. In addition to contamination and channelization, the disturbance regime includes road building and a history of agricultural land use. Even though overall road density within the project area is relatively low, Highway 48 runs parallel to the Creek along the entire project length and four small agricultural roads cross the channel via small bridges. All of these roads do not appear to have a direct impact on the stream channel. Where the stream comes close to Highway 48, banks are not reinforced and erosion rates appear to be the same as those observed for meander bends on the north bank.

Figure 3-6. Lower Warm Springs Creek and Section 32 Project Areas
Warm Springs Creek Biological Assessment - Anaconda, MT

CDM Smith

Lower Warm Springs Creek has a long history of disturbance from farming and ranching land uses; however, agricultural activities were more intense historically than they are in the present day. Farmed areas on the south bank of Warm Springs Creek often contain 20-25 feet of maintained grass buffer. In some places this buffer narrows to 10 feet wide. This narrow grass buffer likely does little to prevent nutrient run-off, therefore a wooded riparian area would trap sediments and nutrients more effectively.

Lower Warm Springs Creek largely contains a C-type channel with moderate to high width-to-depth ratios (> 12). The sinuosity of the stream channel within Lower Warm Springs Creek contributes to a high level of habitat heterogeneity. In most non-channelized areas, the stream has well developed riffle-pool complexes. Deep pools are relatively common, particularly along outside meander bends, and pool variability is high with shallower scour pools also present. Banks are relatively stable. Undercut banks are common, with the extensive root network of dense willow stands largely preventing bank sloughing. Banks are steep and are often nearly vertical with an average height of 4-5 feet. These steep banks reduce floodplain connectivity; however, the majority of the floodplain can be accessed during 10-year flood events.

The substrate within the Lower Warm Springs Creek Project Area is generally a mixture of cobble, gravel, sand, and silt with finer sediments becoming more common moving downstream (CDM 1999). The dominant substrate consists of small cobbles and gravels with fine sediments located primarily in deep pools. Where fine sediments do accumulate, they tend to consist of primarily sand-sized particles. Large gravel bars are common within the stream channel, particularly on the inside of meander bends. Gravel bars are largely devoid of vegetation, but in areas where fine sediment is deposited, it supports the growth of grasses and goldenrod. While very little in-stream vegetation exists, the project area has a significant amount of overhanging vegetation which provides stream shading, cover, and food sources in the form of terrestrial insects falling into the water.

The groundwater table is at the ground surface over much of the project area, and these wet conditions coincide with thick organic muck soils or peat. The groundwater inputs and hydric soils support significant wetland areas and willow flats, particularly to the north of the channel. While rare, some backwaters and side channels exist and are largely surrounded by thick stands of willow. In the drier portions of the project area, vegetation is less dense and bare areas are present consisting of chalky, dusty soils with evidence of cattle grazing (CDM Smith 2012).

In 2007, riparian assessment and temperature studies were conducted at select locations on Warm Springs Creek alongside fish sampling activities. At RM 1.8 (i.e., the closest assessment location to the project area) the stream was classified as Rosgen C channel type. C type channels are typical in broad valleys and in cottonwood-willow riparian corridors. They are riffle-pool systems with well-developed floodplains, meanders, and point bars, and are characterized by moderate to high width-to-depth ratios, high sinuosity, and gently sloping banks. C type channels may be fairly stable when banks and floodplain are well vegetated, and generally provide important fish habitat. C type channels migrate naturally over time, and restricting meander or bank movement can lead to severe instability (MDNRC 2001).

The plant community at RM 1.8 was comprised mainly of dense willows (*Salix* sp.), with alder (*Alnus* sp.), wild rose (*Rosa* sp.), dogwood (*Cornus* sp.), and snowberry (*Symphoricarpos albus*) also relatively common throughout the reach. Undesirable and disturbance-induced plants and noxious weeds, including Canada thistle (*Cirsium arvense*) and spotted knapweed (*Centaurea maculosa*), were widely distributed. Fish habitat was rated as excellent due to frequent deep meander pools, as well as rootwads and overhanging vegetation. Spawning habitat was relatively abundant and flow was good at the time of the survey in early September. However, two unscreened State controlled diversions were noted in the RM 1.8 reach. Maximum daily temperatures at the nearest recorded location, RM 1.0, exceeded 15°C on 58 days with a maximum-recorded temperature of 21.2°C on July 19 (Montana FWP 2008).

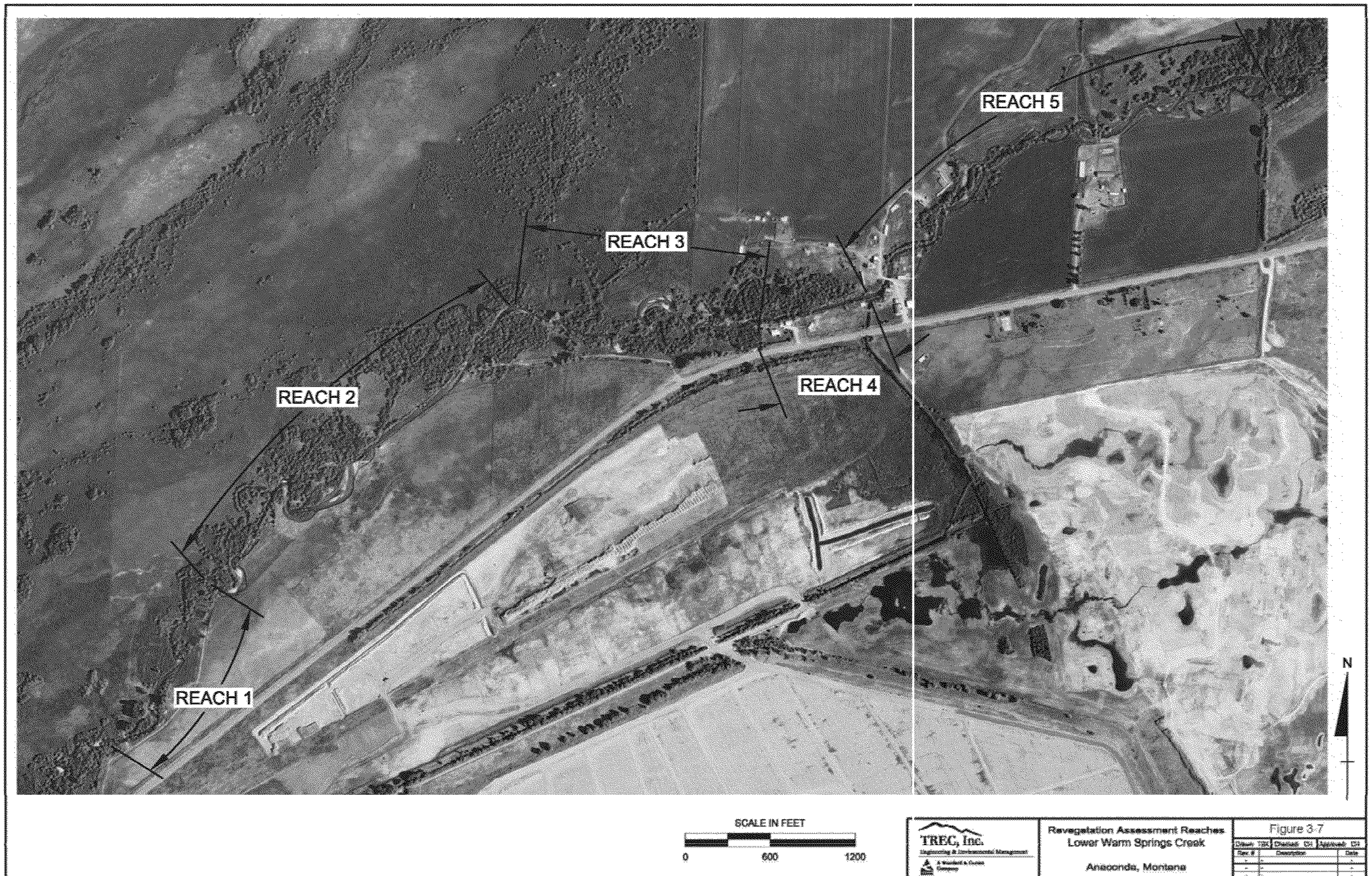
Additional water temperature data, obtained from the USFWS gage at Warm Springs for the years 2001-2012 indicates that monthly mean temperatures all fall below the 15°C bull trout suitability threshold, with July recording the highest mean temperature of 14.6°C. However, daily mean maximum temperatures routinely exceed the suitability threshold beginning in mid-June and ending in early September.

Recent assessments of the plant community within the Lower Warm Springs Creek Project Area document a system dominated by hydrophytic (wetland) vegetation (CDM Smith 2012). The landscape is quite variable, ranging from wetlands and wet meadows dominated by Baltic rush (*Juncus balticus*) and bulrush (*Scirpus* sp.) to stands of aspen (*Populus* sp.) and willow. Seasonal, sub-irrigated pastures used for cattle grazing are present in upland positions and harbor numerous bare areas and sparse stands of scratchgrass (*Muhlenbergia asperifolia*) and redtop grass (*Agrostis alba*).

TREC, Inc. completed "The Lower Warm Springs Creek Vegetation Assessment" in December 2013. This assessment provides details on the Lower Warm Springs Creek corridor including a revegetation assessment of five reaches of the area (see **Figure 3-7**). The assessment summarized that the Lower Warm Springs Creek corridor is a complex of community types including upland herbaceous, riparian herbaceous, shrub wetland, and emergent wetland, with the majority of the corridor being comprised of riparian forested/shrub communities. The five reaches assessed include the southern portion within Gochanour Ranch (reaches 1 and 2), ARCO-owned land (reach 3), the southern portion of the Johnson Ranch (reach 4), and the northeastern portion of the Johnson property (reach 5) (TREC 2013a).

<u>Reach 1:</u> The vegetation communities within Reach 1 are a mix of upland and riparian grassland, riparian forested/shrubland and shrub/emergent wetland communities associated with existing and historic stream flows (**Figure 3-7**). Along the western portion of reach 1, vegetation communities transition from corridors of riparian shrubs to wet meadows, marshes, and abandoned oxbows. This reach is generally well-vegetated due to an accessible, relatively shallow groundwater table. The stream banks are low terraced and well-vegetated with shrubs, grasses and grass-like species (i.e., sedges and rushes). The shrubs include thinleaf alder (*Alnus incana*), Pacific willow (*Salix lasiandra*), Booth willow (*S. boothii*), Geyer willow (*S. geyeriana*), sandbar willow (*S. exigua*), Bebb willow (*S. bebbiana*), water birch (*Betula occidentalis*) and dogwood (*Cornus stolonifera*). Scattered black cottonwoods (*Populus trichocarpa*), quaking aspen (*Populus tremuloides*), Wood's rose (*Rosa woodsii*) and gooseberry (*Ribes* sp.) are adjacent to the stream, but in drier floodplain areas (TREC 2013a).

Herbaceous vegetation across the floodplain is diverse with a mix of predominantly non-native upland grasses and native wetland species. Common species included redtop, Kentucky bluegrass (*Poa pratensis*), interior bluegrass (*Poa interior*), creeping meadow foxtail (*Alopercurus arundinacea*), meadow fescue (*Festuca pratensis*), Baltic rush, Nebraska sedge (*Carex nebrascensis*), cinquefoil (*Potentilla gracilis*), small-winged sedge (*Carex microptera*), western wheatgrass (*Pascopyrum smithii*), plantain (*Plantago eriopoda*), Great Basin wildrye (*Leymus cinereus*), and clover (*Trifolium* sp.) (TREC 2013a).



DRAWING: 9202-0122-FIG-CDM_REVEG.DWG

CDM Smith

Reach 2: The riparian shrub corridor of Reach 2 splits and occupies two distinct areas west of Warm Springs Creek (**Figure 3-7**). The primary shrub corridor is located adjacent the water's edge or along extensive areas of gravel and cobble deposition. This area is flooded annually during spring runoff and gradually dries out over the course of the summer as stream flows decline. These dry conditions and unconsolidated substrates with fine sediments support development of weedy vegetation, with invasive and noxious weed species such as spotted knapweed, common mullein (*Verbascum thapsus*) and houndstongue (*Cynoglossum officinale*) often present. Areas with more sand and increased water availability including saturated soils or surface water inundation for most of the growing season do not support the same weed populations (TREC 2013a).

The primary shrub corridor along the inside meander of Warm Springs Creek includes a narrow band of dense overstory shrubs consisting of mature, healthy stands of thinleaf alder, Pacific willow, planeleaf willow (*Salix planifolia*), sandbar willow, water birch, dogwood and Booth willow (**Figure 3-7**). The herbaceous understory is fairly sparse as a result of seasonal flooding and dense overstory cover with redtop, slender wheatgrass, Kentucky bluegrass, clover, quackgrass, horsetail (*Equisetum* sp.) and Baltic rush present.

Further downstream, as the channel straightens, the linear shrub corridor becomes discontinuous with scattered individual or random shrubs within a grass-dominated upland. Vegetation of this area includes a variety of mixed age and shrub size willows with alder and some birch in the slightly lower areas or depressions with shallow surface water. The willows include primarily Booth, Geyer and Bebb species. The herbaceous understory includes a mix of redtop, Kentucky bluegrass, clover, meadow fescue and native species such as slimstem reedgrass (*Calamagrostis stricta*), Baltic rush, slender wheatgrass (*Agropyron trachycaulum*), and western wheatgrass. Small isolated patches of golden currant (*Ribes aureum*) and Wood's rose occur on slightly higher, drier hummocks adjacent to the water. The presence of non-native species such as Canada thistle along with areas of prolific Baltic rush indicates a past history of disturbance in this area, possibly due to grazing or hydrologic alteration. Hydrophytic vegetation such as Baltic rush, small-winged sedge, and Nebraska sedge are still present in the uplands. Some floodplain areas that were over-browsed have become dominated by Bebb willow, a shrub that is resilient to heavy grazing. In areas where there has been prolonged disturbance, willow coverage has decreased, resulting in a more open canopy and herbaceous vegetation that has transitioned to a grass dominated system including Kentucky bluegrass, fescue, Baltic rush and redtop (TREC 2013a).

Reach 3: The middle reach, Reach 3, contains large areas of emergent wetlands, shrub wetlands, and riparian forested/shrub community types (**Figure 3-7**). Uplands represent a very small portion of the stream corridor and floodplain. The central or middle portion of Reach 3, on the western side, includes a mosaic of sedge, rush, grass, and forb dominated wetlands with large interspersed communities of shrub willows. The forested/shrub corridor along the creek includes water birch, thinleaf alder, Pacific willow, planeleaf willow, Booth willow, Drummond willow (*Salix drummondiana*), chokecherry (*Prunus virginiana*), and sandbar willow. Cottonwood trees are fairly common within drier portions of the floodplain. Several age classes and diverse woody species are represented in the overstory, resulting in high structural complexity. Most banks are secure and dominated by deep- rooted trees, shrubs and grass-like species (sedge/rush) providing overhanging vegetative cover. Cobble or gravel point bars are common in this reach, and vegetation density varies from sparse willow seedlings and grasses to dense young sandbar willows and thick herbaceous cover by redtop, sedges and various forbs. Eroding or cut banks are dominated by introduced perennial grasses such as smooth brome (*Bromus inermis*), quackgrass, creeping meadow foxtail, timothy (*Phleum pratense*) and redtop.

Spotted knapweed was noted in the drier upland areas. Canada thistle was fairly common in the uplands, along the stream corridor, and in some wetland areas (TREC 2013a).

Reach 4: The vegetation communities within Reach 4 are a mix of upland shrub and broad dense riparian forested/shrubland along the western side of the creek **(Figure 3-7)**. Small riverine wetlands are limited to depositional points or side bars or low terraces along the channel as a result of deposition. Within Reach 4, some portions of the Warm Springs Creek channel have become entrenched with areas of steep, high cut banks, and floodplains disconnected from the channel, resulting in an upland floodplain terrace. Some woody species regeneration is occurring along the lower banks, channel edge, and within the riverine wetlands, but little regeneration occurs in the floodplain. Primarily alder and birch, with some shrub willows (i.e., Pacific willow and sandbar willow), cottonwood, chokecherry, Woods rose, shrubby cinquefoil (*Pentaphylloides floribunda*) and currant are present within the riparian corridor. Many of the woody plants, including alder and birch, are declining or unhealthy. The herbaceous understory in the dry floodplain includes species such as quackgrass, smooth brome, redtop, tall fescue (*Festuca arundinacea*), and Baltic rush. Canada thistle is a common invasive species in the dry floodplain; other invasive species include houndstongue, spotted knapweed, and cheatgrass (*Bromus tectorum*). Bare or sparsely vegetated surfaces are common within the northern upland floodplain, invasive species have expanded, and damage or injury to trees and shrubs has resulted (TREC 2013a).

Reach 5: Reach 5 land uses include pasture/grazing and crop production (i.e., grain and hay) (**Figure 3-7)**. Generally, where grazing is restricted or absent, the complexity of the vegetation structure is higher, which results in stable banks and reduced soil erosion. In heavily grazed areas, or immediately adjacent to crop land, woody species cover is reduced and occurs with a dominance of non-native herbaceous species, and in some cases, eroding banks. In general, vegetation communities within Reach 5 include riparian forested/shrub along the stream corridor with uplands (i.e., grass and crop) dominating the eastern side of the stream and portions on the west side. The tree/shrub overstory of Reach 5 includes birch, alder, Pacific willow, peachleaf willow (*Salix amygdaloides*), Drummond willow, Booth willow, sandbar willow, Bebb willow, dogwood, and chokecherry. Shrub density ranges from a dense overstory to small scattered patches of alder and birch. Wetlands are small and generally confined to the bank edge or low bank terraces, or as depositional areas within inside meanders. Common herbaceous species along the banks and in the pastures include redtop, bluegrass (*Poa* sp.), slender wheatgrass, quackgrass, smooth brome, timothy, orchardgrass (*Dactylis glomerata*), clover and Kentucky bluegrass. Noxious weeds include some Canada thistle and spotted knapweed (TREC 2013a).

3.3.1.2 Section 32 Project Area

The Section 32 Project Area is located within that lower reaches of Warm Springs Creek at approximately RM 7.0 to RM 8.3. The project area is bounded to the east by the airport road crossing (Mertzig Road) and to the west by Galen Road (**Figure 3-6**). Upstream of the Section 32 Project Area, the channel appears natural until it reaches the Galen Road crossing. Approximately 1,000 feet downstream of this road crossing, begins a braided, depositional reach extending approximately 1,600 feet to the east. A large debris dam causes flow to leave the main channel, resulting in a loss of approximately 50 percent of its flow. While most of the flow is lost to a series of small channels to the northeast, about 10 percent of flow is diverted to a small side channel to the south of the main channel. Continuing downstream of the first debris dam, the main channel narrows but does not gain much depth due to water loss to side channels. The main channel is relatively abandoned for approximately 1,000 feet and water flows slowly through what has largely become a backwater pool system. Within this abandoned section, some stream reaches go dry.

The braided channel system consists of approximately 40 small, dendritic drainage channels that branch out from the main channel at the first large debris dam and slowly flow to the east before ponding due to beaver activity and an existing berm on the west side of the island. Within the braided stream system, overland flows result in significant deposition to the northeast of the main channel. This deposition raises streambed elevations and contributes to the transition to an alluvial fan – freshwater marsh system characterized by standing water and emergent vegetation that flows slowly eastward. Beaver activity is also cited as a primary reason for this transition.

Due to large width-to-depth ratios, this braided system is indicative of a Rosgen D or D_A channel type. Both stream types are associated with broad, alluvial valleys and alluvial fans. Bankfull flows are likely only maintained within the main channel for short periods. Both stream types exhibit depositional characteristics, and the loss of hydraulic capacity within this braided system is likely the result of significant sediment deposition. This sediment originated from upstream of Galen Road and was probably mobilized by the high hydraulic capacity caused by channelization near Anaconda. At the Galen Road bridge, it appears that the channel has been graded to increase conveyance and to end the multiple channel situation just downstream of the bridge. If the bridge were not there, the stream channel would likely increase its width and migrate to the north where the secondary channel is now located and where the creek has historically flowed (CDM 1999).

Eventually, water flows through the braided portion of Section 32 and drains into either the north or south main channel. Prior to 2011, the north channel was largely ephemeral. Field investigations in the late 1990s (during low flow) found it dry and vegetated but well defined (CDM 1999). Post 2011, the north channel is a perennial system and flow is roughly split evenly between it and the south channel. The south channel is slightly larger than the north channel. The south channel also contains greater pool variability and more large pools. Some of these pools reach depths of 4-5 feet and serve as refuges for aquatic species during periods of high temperatures or low flow. After separately winding northeastward for approximately 4,000 feet, the north and south channels combine approximately 750 feet upstream of Mertzig Road. Downstream of this confluence, Warm Springs Creek contains a well-defined riffle/pool system with a high level of habitat heterogeneity.

Within the Section 32 Project Area, the channel substrate consists of a mixture of cobbles and fines with silt observed more frequently than sand moving downstream (CDM 1999). Even in the braided reach, few fine types of sediment are observed and constitute less than 25 percent of the substrate. Where fine sediment does occur, it tends to be deposited near channel banks and within deep pools, with greater deposition being observed in the smaller fingers of the alluvial fan system and in active beaver areas.

The stream corridor within the Section 32 Project Area was contaminated via multiple pathways including aerial deposition from the smelter complex, fluvial deposition from historic flooding, re-suspended dusts from barren and sparsely vegetated areas, and deposition of fugitive dust from the nearby tailings ponds. Sample data from soils indicate that the arsenic open space action level of 1,000 mg/kg is often exceeded along Section 32 stream corridors. Data also show that copper is present in very high concentrations. Sampling of the underlying soils after surficial layers were stripped until arsenic concentrations were below 250 mg/kg indicate that while much of the highest concentrations were removed by earlier remedial actions, copper still remains in the floodplain at moderate to high concentrations (CDM Smith 2012).

Due to upstream channelization, sediment deposition, water diversion, debris accumulation, and beaver activity, Warm Springs Creek within Section 32 is prone to freezing over, with some sections freezing completely. The low velocities and shallow depths associated with large portions of Section 32 also contribute to the formation of ice dams. In February 2013, ice dams located upstream of the braided system were causing water to spill out of the channel and into adjacent fields to the north and south. At the same time, portions of the stream with higher velocities were freezing from the bottom to the top of the water column. The fast flows prevent ice from forming except along the bottom of the streambed where friction and turbulence allow the water to slow down long enough to freeze. This condition not only contributes to flooding, but degrades aquatic habitat by preventing access to the cover provided by the interstices between cobbles and boulders.

In 2007, two riparian assessment points (i.e., RM 7.4 and RM 8.4) were located within or adjacent to the Section 32 Project Area. At RM 7.4, the riparian vegetative community existed in a narrow band directly adjacent to the channel and was comprised mostly of stunted cottonwood trees, willow, and alder. Fish habitat was fairly good in this reach, with a number of deep pools present. Upstream of this section, from RM 7.8 to 8.1, the stream channel becomes severely braided. While the many small channels created a wide, dense riparian area, many of the channels appeared unstable and migrations were evident (Montana FWP 2008).

At RM 8.4, located upstream of the Galen Road bridge, the channel has been historically channelized and a berm was built to prevent flooding. This reach is straight, wide, shallow, and generally lacks suitable habitat for larger, adult fish. The plant community at RM 8.4 is limited, and consists primarily of stunted cottonwood and aspen trees growing on berms adjacent to the channel. Gardiner Ditch, a large irrigation diversion, is located immediately upstream of Galen Road (Montana FWP 2008).

No temperature data were collected at either of these two sites. The nearest point where water temperature data were collected was at RM 13.2. Maximum daily temperatures were notably cooler than at RM 1.0, and exceeded 15°C on only 11 days. The maximum recorded temperature at this site was 16.6°C, which occurred on July 19 (Montana FWP 2008).

In 2009-2010, Atlantic Richfield remediated large portions of the Section 32 Project Area. Prior to remediation, the landscape consisted of barren, denuded, and sparsely vegetated areas contrasted with areas of good water availability supporting significant vegetation growth. An upland grass mixture was planted that is specifically designed to tolerate high concentrations of copper and other metals in the soil. The vegetation in open areas is currently dominated by wheatgrasses, basin wildrye, fescues, and redtop. A moderately dense canopy is present and consists largely of aspen, birch, cottonwood, and willow (CDM Smith 2012).

TREC, Inc. conducted vegetation surveys in August 2013 and the results largely confirm that the vegetation community discussed above is present within the Section 32 Project Area. The riparian corridor along the upstream reference reach of Section 32 includes primarily black cottonwood, with an occasional scattered shrub willow, quaking aspen, and dogwood. Mature cottonwoods grow on the banks and within the channel itself. Cottonwood roots systems create bank cavities and serve as in-stream structure. There is little evidence of aquatic vegetation. The coldwater, fast-moving stream, and rocky substrate prevent the establishment of vegetation. Drought tolerant shrubs along the top of bank include Wood's rose, snowberry, golden currant, and common chokecherry. The dominant herbaceous species is primarily redtop grass. However, the herbaceous cover at the top of bank rarely exceeds 50 percent coverage due largely to the presence of rocky soils. Herbaceous coverage increases as you move away from the channel and encounter more suitable substrate. The riparian corridor in this portion of Section 32 is fairly narrow due to bank heights, significant depth to groundwater (> 50 ft.), and historic disturbance (TREC 2013b).

Further downstream, within the braided section of Section 32, the riparian corridor is broader with lower bank heights, and is characterized by an increase in woody cover density and species diversity. Woody species include black cottonwood, thinleaf alder, dogwood, and shrub willows including Geyer Willow, Bebb willow, and Drummond willow. Species composition within the braided portion of Section 32 is highly dependent on the hydroperiod, which is influenced by the frequency of flooding and saturated soil conditions. Emergent herbaceous species, largely consisting of tall wetland grasses, are more common in areas with longer periods of saturation including areas with recent beaver activity. Currently, the system is in transition and the change in hydroperiod may submerge roots and scour soils resulting in the loss of mature trees and a change to a scrub-shrub wetland system dominated by willows. Elevated, drier portions support facultative species, whereas, lower wetland areas are dominated by hydrophytic species (TREC 2013b).

3.3.2 Reference Reaches

A reference reach is a stream-type model and a blueprint for remediation activities. The reference reach is used to develop natural channel design criteria based upon measured morphological relations associated with the bankfull stage for a specific stable stream type (Rosgen 1998). The collected morphological data is used for extrapolation to disturbed or unstable reaches in similar valley types for the purposes of restoration, stream enhancement, stabilization, and stream naturalization schemes (Rosgen 1998).

USEPA and its partners have identified Warm Springs Creek between the Section 32 and Lower Warm Springs Creek project areas as a potential reference reach for Lower Warm Springs Creek (RM 4.8 to RM 7.0). This same section of Warm Springs Creek is referred to as Reaches 4 and 5, which are reference reaches in the 1999 Montana Department of Justice – Natural Resources Damage Program report "Pre-Design Planning for Restoration Activities, Warm Springs Creek, Anaconda, Montana". The downstream end of the reference reach is located adjacent to the Gochanour Ranch with the reach ending upstream at the airport road crossing (Mertzig Road). Unlike channelized reaches downstream and a disturbed, multiple channel system upstream, the reference reach appears to contain a natural channel throughout. Within the larger reference reach, data collection focused on a 1,400-foot section located approximately 0.5 miles upstream of the Lower Warm Springs Creek Project Area.

The Lower Warm Springs Creek reference reach is characterized by a Rosgen B4c or C4 type single-thread channel. Upstream reaches tend to exhibit more C4 channel characteristics with downstream reaches trending to a degraded C or B4c channel condition (Land and Water 1999). A B4c channel is generally a fairly stable channel, but exhibits a more degraded stream condition than a B4 channel. B type channels possess a moderate to steep grade (>2%), moderate to high width-to-depth ratio (>12), and low bank heights. B type streams are often rapid dominated streams with step-pool sequences, and often have a broader valley but not a well-developed floodplain. Often, B type streams contain irrigation diversions serving pastures lower in the valley, and provide important fish spawning habitat (MDNRC 2001).

A description of C type channels is given in Section 3.3.1.1. A C4 channel differs from other C type channels in that it typically has gravel substrate and a relatively shallower slope (MDNRC 2001).

Overall, the Lower Warm Springs Creek reference reach exhibits slight entrenchment, low to moderate width-to-depth ratios, slopes less than 2 percent, moderate to high sinuosity, and a bed composed of sand, gravel, and cobble. Unlike the Section 32 Project Area located directly upstream, the reference reach typically consists of a single channel and the main channel is likely kept in place, in part, by the airport road bridge acting as a hardpoint. Streambed substrate is dominated by cobbles and sand, and the presence of clay-silt-sand cutbanks indicate that more fines were historically carried by the stream than is presently the case (CDM 1999).

Much of the Lower Warm Springs Creek reference reach has good channel stability with mature riparian vegetation and serves as a reasonably good template for C4 type channels in the surrounding area. Banks tend to be well vegetated with approximately 90 percent coverage. However, localized lateral instability associated with historic meander abandonment is present in upstream areas and grazing has limited regeneration of woody species to some extent. Sediment impacts associated with upstream reaches are relatively absent because much of the bedload material is trapped upstream of the airport road crossing. The lower several hundred feet of the reference reach contains eroding banks due to a lack of riparian vegetation likely influenced by degraded downstream conditions on the Gochanour Ranch (Land and Water 1999).

Large woody debris (LWD) in the Lower Warm Springs Creek reference reach is largely composed of uprooted willows and cottonwood branches. The riparian vegetation is dominated by mature willow thickets and relatively few large, mature cottonwood trees are present. This results in fewer LWD sources, but debris is easily trapped by frequent tight meander bends and cannot flush through the system.

Field activities associated with the preparation of Land and Water's 1999 report included three cross sections within the Lower Warm Springs Creek reference reach. Cross sections provide a snapshot of the physical channel conditions including channel depth, channel slope, and average flow velocity. The information obtained from the three cross sections is presented in **Table 3-3** below.

Table 3-3 Stream data from cross sections located within the Lower Warm Springs Creek reference reach (Land and Water 1999)

Stream Parameter	Cross Section		
	CS 403 + 02	CS 371 + 70	CS 311 + 87
Approximate Distance Downstream from Airport Bridge Crossing (ft)	4,900	8,100	14,100
Bankfull Width (ft)	86.28	28.00	40.68
Bankfull Depth (ft)	1.00	1.70	1.30
Maximum Depth (ft)	2.60	2.40	2.30
Width/Depth Ratio	90.60	16.50	30.30
Channel Slope	0.00567	0.00864	0.00788
Average Flow Velocity (fps)	3.00	5.30	4.60
Bankfull Flow Rate (cfs)	250	250	250
Stream Classification	C4	C4	B4c

While no confirmed recent recorded observations of bull trout have been documented within the Lower Warm Springs Creek reference reach, USFWS has indicated that bull trout potentially use the reach as a migratory corridor. In addition, this reference reach falls within the area of Warm Springs Creek designated as Critical Habitat for the bull trout. Therefore, remediation activities in the project areas will attempt to model conditions present within the reference reach with the expected result being improved conditions within the stream corridor; the goal being to trend toward meeting the minimum requirements bull trout need during migration and overwintering periods.

The Section 32 reference reach, Reach 32A, begins at the Galen Road Bridge and continues downstream approximately 1,000 feet. The reference reach is largely a uniform riffle with cobble-boulder substrate. Very little fine sediment is present and the water is clear, fast-flowing, and cold. Due to an absence of fine sediments, embeddedness of larger substrates is very low and depositional features are absent. The Section 32 reference reach is largely a straight channel section with few meanders. Some microhabitats are present, including small scour pools along banks and low-velocity areas behind larger boulders. A large, deep scour pool was created in 2008 along the right bank near where a former construction access bridge was located. The scour hole has been observed to be as much as 10-feet deep and would provide fish and other aquatic organisms with a thermal refuge. The reference reach is connected to its floodplain during 10-year flood events. The forested riparian buffer consists primarily of large cottonwoods and is approximately 30-feet wide.

The Section 32 reference reach was largely selected due to its channel morphology and its capacity to carry high flows and large amounts of sediment and debris downstream. These attributes are of utmost importance to achieve the remedial goals of Atlantic Richfield and USEPA. While the Section 32 reference reach does not possess optimal aquatic habitat conditions for bull trout, the microhabitats (i.e., scour pools) that exist within the reach could potentially provide foraging habitat and migratory corridors. Additional details on the Section 32 reference reach, including cross sections and pebble counts, can be found in Appendix E, Sub-part 5 of the RAWP (Atlantic Richfield 2013).

3.3.3 Bull Trout Distribution, Status, and Limiting Factors

Historically, the Warm Springs Creek watershed provided a significant portion of bull trout spawning and rearing habitat in the Upper Clark Fork River due to the large area of the drainage, geology, and the presence of diverse habitats. However, a century of mining and smelting degraded bull trout habitat and effectively extirpated migratory bull trout from much of the system (DeHaan and Godfrey 2010). Unpublished data collected by Montana FWP prior to 1970 confirmed the absence of bull trout in the lower reaches of both Warm Springs and Silver Bow Creeks (MBTSG 1995). Continued habitat degradation from mining, urbanization, and agricultural activities has restricted resident life forms to headwaters and upstream tributaries. The presence of Meyers Dam at RM 16.6 has effectively cut off the potential upstream source populations from the lower reaches of Warm Springs Creek.

In an attempt to conserve remaining extant bull trout populations in Warm Springs Creek, in 1995, the Warm Springs Creek drainage was listed by the Montana Bull Trout Scientific Group (MBTSG) as a bull trout core area. A core area is an area that currently supports the strongest remaining populations of bull trout. In addition, the MBTSG identified nodal habitat (i.e., waters containing migratory corridors and overwintering areas) as the Clark Fork River from Warm Springs Creek downstream to the former location of Milltown Dam (MBTSG 1995).

In 2002, the USFWS designated seven bull trout populations within the Upper Clark Fork River core area; however, recent information suggests that bull trout have been reduced to only three viable populations in Warm Springs, Boulder, and Harvey Creek watersheds. Currently, these populations appear to be isolated from one another. Of these three locations, Warm Springs Creek contains the most-upstream bull trout population in the Clark Fork River, is comprised of multiple demes (discrete spawning units in individual tributaries), and likely contains the largest population in terms of numbers of individuals and extent of occupied habitat (DeHaan and Godfrey 2010). As such, USFWS identified the upper 20.2 miles of Warm Springs Creek to its headwaters as occupied migratory and spawning and rearing habitat (USFWS 2010). Fluvial forms are rare, but adfluvial forms exist in Silver and Twin Lakes. Resident forms exist in most of the larger tributaries upstream of Anaconda including Barker, Foster, Twin Lakes, and Storm Lake Creeks (Montana FWP 2012).

Due to the presence of bull trout populations in upstream portions of the Warm Springs Creek watershed and the potential for them to serve as source populations for lower Warm Springs Creek and other streams in the Upper Clark Fork River Basin, USFWS has designated the entire length of Warm Springs Creek and its headwaters as critical habitat for bull trout (USFWS 2010). This includes the lower reaches of Warm Springs Creek that flow through the Section 32 and Lower Warm Springs Creek project areas (**Figure 3-8**).

Fish surveys of Warm Springs Creek in 2007 identified brown and *Oncorhynchus* species (i.e., designation used at sites where rainbow trout and westslope cutthroat or potential hybrids between these species occurs) at RM 1.8, RM 7.4, RM 8.4, and RM 16.4. Brown trout dominated the species composition making up 99 percent or greater of the fish collected at RMs 1.8, 7.4, and 8.4. Although approximately equal numbers of brown trout were captured at RM 7.4 and 8.4, fish at the upstream site were notably smaller. At RM 16.4, brown trout continued to be the most abundant trout species present; however, *Oncorhynchus* species comprised 10 percent of the composition at the site. No bull trout were collected below Meyers Dam, located at RM 16.6 (Montana FWP 2008).

During 2007 fish sampling events, the species composition found above Meyers Dam differed significantly from sampling locations located below the dam [this structure serves as a barrier to trout going to Upper Warm Springs Creek (Montana FWP 2010)]. Above the dam at RM 18.6, brown (5%), *Oncorhynchus* (87%), bull (6%), and brook trout (2%) were found. At RM 23.3, no brown or bull trout were collected, and trout composition consisted entirely of *Oncorhynchus* (65%) and brook trout (35%). However, bull trout (40%) were the most abundant species collected at RM 27.4, with westslope cutthroat (27%) and brook trout (30%) being almost equally common. One relatively large bull trout – brook trout hybrid was also noted in this reach.

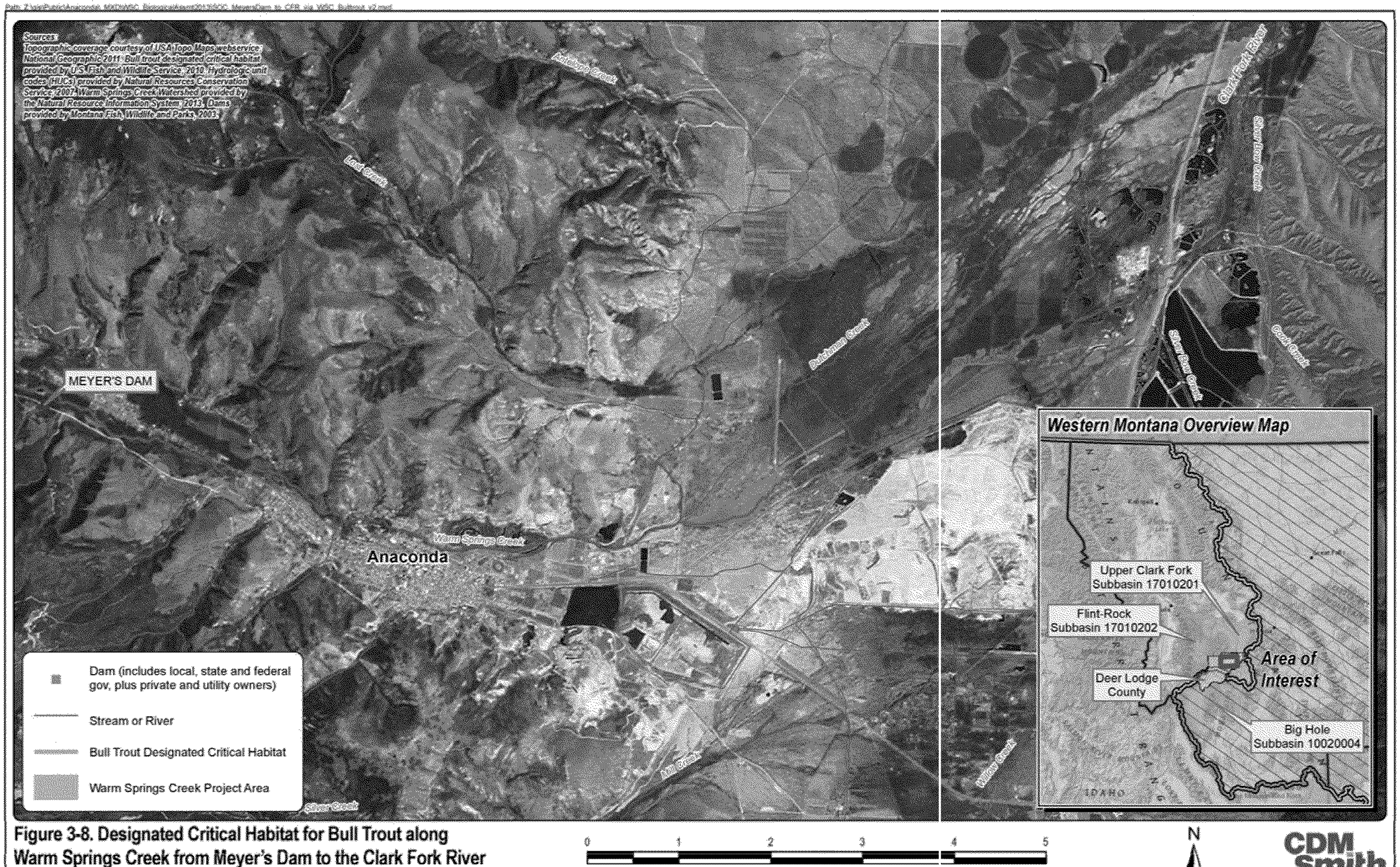


Figure 3-8. Designated Critical Habitat for Bull Trout along Warm Springs Creek from Meyer's Dam to the Clark Fork River
Warm Springs Creek Biological Assessment - Anaconda, MT

Bull trout have also been recently documented in several tributaries to Warm Springs Creek. In 1995, the Warm Springs Creek drainage contained primarily resident populations of bull trout located in headwater streams, Barker Lake, Storm Lake, Twin Lakes, and Cable and Foster Creeks. Adjacent stream systems including Lost Creek, Racetrack Creek, and Schwartz Creek also contained bull trout (MBTSG 1995). In 2007, bull trout were collected in several tributaries to Warm Springs Creek including West Fork Warm Springs Creek, Barker Creek, Foster Creek, Twin Lakes Creek, and Storm Lake Creek. However, fish sampling in 2007 did not record a single bull trout in Cable Creek or Racetrack Creek (Lost Creek and Schwartz Creek were not sampled) (Montana FWP 2008).

Several additional studies also document bull trout above Meyers Dam. The 2011 Montana FWP report "An Inventory of Irrigation Structures in the Upper Clark Fork River Drainage, Montana" indicates that the trout community in much of upper Warm Springs Creek is comprised largely of westslope cutthroat trout and bull trout, with brook trout, rainbow trout and the occasional brown trout also present (Montana FWP 2011).

In addition to the large, resident populations of bull trout present in the upper reaches of Warm Springs Creek, bull trout have been reported in the upper reaches of lower Warm Springs Creek below Meyers Dam. However, population density in these lower reaches appears to be very low. One adult has been found below Meyers Dam, as documented in the irrigation diversion survey report from 2011. The survey report shows the presence of a single bull trout at the head of Gardiner Ditch, which is located just upstream of the Section 32 Project Area at RM 10.3 (Montana FWP 2011). It is likely that fish below Meyers Dam are incidental migrants from Upper Warm Springs Creek and its connected tributaries.

While bull trout have recently been documented at low densities, the likelihood of bull trout occupancy in Warm Springs Creek has increased since 2008, as a result of the removal of Milltown Dam, which eliminated a barrier to bull trout migration to the Upper Clark Fork River watershed and Warm Springs Creek. In addition, USFWS has designated the lower 10.6 miles of Warm Springs Creek as foraging, migration, and overwintering habitat (FMO) (USFWS 2010). Therefore, habitat conditions exist to support bull trout seasonally.

Within Warm Springs Creek, several factors limit bull trout distribution. As noted previously in this section and in Section 3.2.4, bull trout require specific water temperatures in order to complete their life cycle. Within the lower reaches of Warm Springs Creek below Meyers Dam, water temperatures have routinely exceeded the 15°C threshold tolerated by adult bull trout. Above Meyers Dam, temperatures are noticeably cooler and fall within the range favored by adult and juvenile trout. While temperature data indicate that both project areas are unsuitable for spawning, deeper pools within the lower reaches of Warm Springs Creek could provide adult bull trout with foraging and overwintering habitat.

In addition to temperature, substrate type and the rate of sedimentation can influence whether bull trout are present. In the lower reaches of Warm Springs Creek, cobbles and gravel are present but historical mining and beaver activities have introduced fine sediments into the system. In some areas, this historically-deposited fine sediment has filled the interstices between larger substrate and has eliminated the habitat for favored bull trout prey items (e.g., macroinvertebrates). Increased sedimentation, largely due to agricultural activities on adjacent properties, has continued to deposit fine sediment; thereby, smothering the large substrate habitat on which bull trout rely.

Within Warm Springs Creek, the introduction of non-native brook and brown trout also limit the distribution of bull trout. In Warm Springs Creek below Meyers Dam, brown trout make up greater than 90 percent of the fish community. This is due in part to the observation that brown trout are more tolerant than bull trout of variable environmental conditions (e.g., water temperature) and can therefore occupy a greater diversity of habitats. However, in places where brown trout and bull trout co-exist, the prolific brown trout often out-competes bull trout.

Even in areas of Warm Springs Creek where brown trout have largely been excluded, such as in tributaries above Meyers Dam, bull trout are threatened by hybridization with brook trout. Brook trout occupy similar habitats as bull trout and the species have been known to interbreed. Hybridization can reduce pure bull trout genetic stock and represents wasted reproductive effort. While hybridization is rare in Warm Springs Creek, it has been documented above Meyers Dam where both species coexist (Montana FWP 2008).

Barriers to fish passage and flow alterations also limit bull trout abundance. In Warm Springs Creek, impediments to fish passage include dams and flow alterations that are primarily the result of irrigation diversions. Meyers Dam is the most significant barrier to bull trout moving between upstream and downstream reaches. Meyers Dam prevents existing bull trout populations from recolonizing suitable habitat downstream and intermixing with other populations within the Upper Clark Fork Basin. However, the dam also serves as a barrier to the upstream migration of brown trout; therefore, protecting fragile upstream populations of bull trout from this competitor.

Irrigation diversions are common throughout the Warm Springs Creek watershed and impact bull trout through flow alteration and direct take. Diversions alter the flow within the main channel of Warm Springs Creek by pulling out significant water volumes during the growing season. While recent agreements have lessened the impacts of these withdrawals, irrigation diversions can still influence aquatic habitats, particularly during drought events. Direct take of fish occurs when individuals are swept through an irrigation diversion and cannot return to the main channel or are deposited in agricultural fields. In 2011, the single bull trout specimen recorded below Meyers Dam was found at the top of Gardiner Ditch, located just upstream of the Section 32 Project Area (Montana FWP 2011).

A detailed discussion of all limiting factors for bull trout can be found in Section 3.2.4 Habitat Requirements and Section 3.2.5 Key Survivability Factors

3.3.4 Bull Trout Management

In 2002, the USFWS published a Bull Trout Recovery Plan for the Clark Fork River Recovery Unit and designated the Upper Clark Fork River – Section 1, which includes Warm Springs Creek, as a primary core area. A core area represents the closest approximation of a biologically functioning unit for bull trout and consists of core habitat and a core population. These core areas are the units used to gauge bull trout recovery. The specific goal of the Recovery Plan is to ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed throughout the Clark Fork River basin so that the species can be delisted. The numeric standards necessary to achieve recovered abundance of bull trout in the Upper Clark Fork River are:

- Five (5) recovered local populations with > 100 individuals
- 1,000 individual adults recovered within the core area

As of the 2002 Recovery Plan, there were 13 existing local bull trout populations in the Upper Clark Fork River, none of which exceeded 100 individuals.

The USFWS Bull Trout Recovery Plan has been supplemented by several bull trout management plans specific to the state of Montana. The MBTSG's final restoration plan, issued in 2000, focuses activities on 12 restoration/conservation areas (RCAs) and is designed to complement the Recovery Plan. The MBTSG's Montana Restoration Plan recommends a multitude of habitat restoration projects to increase the size and health of bull trout populations. Restoration projects include removing fish passage barriers, screening irrigation diversions, fencing riparian areas, restoring streams, and monitoring habitat (USFWS 2002).

Warm Springs Creek is included in the Upper Clark Fork RCA. The goals listed in the Montana Restoration Plan for the Upper Clark Fork RCA include (MBTRT 2000):

- Maintain self-sustaining bull trout populations in all the watersheds where they presently exist
- Maintain the population genetic structure throughout the watershed
- Reestablish a migratory corridor between the upper Clark Fork and middle Clark Fork
- Restore the connectivity within the Clark Fork River
- Establish a self-reproducing migratory population in the Clark Fork River which is connected to, and spawns in, tributary streams
- Maintain a count of at least 100 redds or 2,000 total individuals in the migratory population over a period of 15 years (at least three generations), with spawning distributed among all identified core areas

The management direction contained within the Draft Statewide Fisheries Management Plan 2012-2018 (Montana FWP 2012) recommends continuing yearlong closure on angling for bull trout within the Warm Springs Creek watershed and its tributaries to support the goal of enhancing migratory and resident populations for conservation.

Section 4

Crosswalk Analysis between the Bull Trout Matrix of Pathways and Indicators (MPI) and the Primary Constituent Elements (PCEs) of Proposed Critical Habitat

4.1 Overview and Purpose

The Matrix of Pathways and Indicators (MPI) for bull trout is used to evaluate and document baseline conditions and to aid in determining whether a project is likely to adversely affect or result in the incidental take of bull trout. The MPI analysis incorporates four population indicators and 19 physical habitat indicators, which are provided below (USFWS 2004).

MPI – Population Indicators

- Subpopulation size
- Growth and survival
- Life history and diversity
- Persistence and genetic diversity

MPI – Physical Habitat Indicators

- Temperature
- Sediment
- Chemical contamination/nutrients
- Physical barriers
- Substrate embeddedness
- Large woody debris (LWD)
- Pool frequency and quality
- Large pools
- Off-channel habitat
- Refugia
- Wetted width/depth ratio
- Streambank condition
- Floodplain connectivity
- Change in peak/base flows
- Drainage network increase
- Road density and location
- Disturbance history
- Riparian conservation areas
- Disturbance regime

Analysis of the 19 habitat indicators provides a thorough evaluation of the existing baseline condition for the Section 32 and Lower Warm Springs Creek project areas (**Table 4-1**). Several baseline indicators for both project areas and Warm Springs Creek as a whole were previously assessed in detail in Section 3. Information first presented in Section 3 was combined with data from site assessment reports and fish community surveys to determine if each MPI physical indicator is functioning appropriately (FA), functioning at risk (FAR), or functioning at unacceptable risk (FUR).

Both project areas are FUR for each of the four population indicators, due largely to the absence of confirmed self-sustaining bull trout populations. Of the 19 habitat indicators, the Section 32 Project Area contains 11 that are FAR and 8 that are FUR, and the Lower Warm Springs Creek Project Area contains 2 that are FA, 12 that are FAR, and 5 that are FUR. The degraded nature of the stream as a result of historical disturbances has contributed to a loss of function; therefore, both stream reaches are ideal candidates for habitat restoration activities.

Table 4-1 Matrix of Pathways and Indicators. Baseline indicators and documentation for bull trout in Warm Springs Creek –Lower Warm Springs Creek and Section 32 remediation areas

Indicator	Section 32 Values	Rating	Lower Warm Springs Creek Values	Rating
Population Indicators				
Subpopulation size	Unknown but observations are rare. Likely less than 50 individuals, largely fragmented system dominated by brown trout.	FUR	Unknown but observations are rare. Likely less than 50 individuals; largely fragmented system dominated by brown trout.	FUR
Growth and survival	No trend data available to assess this indicator. Generally low numbers of individuals in scattered locations.	FUR	No trend data available to assess this indicator. Generally low numbers of individuals in scattered locations.	FUR
Life history and diversity	Migratory bull trout exist only within the Warm Springs Creek watershed above Meyers Dam. Migratory corridors are fragmented and have degraded water quality and habitat conditions.	FUR	Migratory bull trout exist only within the Warm Springs Creek watershed above Meyers Dam. Migratory corridors are fragmented and have degraded water quality and habitat conditions.	FUR
Persistence and genetic integrity	Bull trout exist as isolated populations increasing the likelihood of reduced genetic variation. The presence and threat of brook trout hybridization and competition with other nonnative species occurs in the drainage.	FUR	Bull trout exist as isolated populations increasing the likelihood of reduced genetic variation. The presence and threat of brook trout hybridization and competition with other nonnative species occurs in the drainage.	FUR
Physical Habitat Indicators				
Temperature	Based on the abundance of water diversions, flow diverted during the irrigation season, water depth, and stream shading. Braided system reduces water quantity in main channel. Areas of the reach with overhanging vegetation tend to contain lower water temperatures. The USGS stream gage at Warm Springs indicates that monthly mean temperatures from 2000-2012 all fall below the 15°C bull trout suitability threshold, with July recording the highest mean temperature of 14.6°C. However, daily mean maximum temperatures routinely exceed the suitability threshold (i.e., 15°C) beginning in mid-June and ending in early September. Thermal refugia (i.e., deep pools) could help bull trout avoid heat stress.	FAR	Based on the abundance of water diversions, flow diverted during the irrigation season, water depth, and stream shading. Water diversions are more common than in Section 32. Areas of the reach with overhanging vegetation tend to contain lower water temperatures. USGS stream gage at Warm Springs indicates that monthly mean temperatures from 2000-2012 all fall below the 15°C bull trout suitability threshold, with July recording the highest mean temperature of 14.6°C. However, daily mean maximum temperatures routinely exceed the suitability threshold (i.e., 15°C) beginning in mid-June and ending in early September. Thermal refugia (i.e., deep pools) could help bull trout avoid heat stress.	FAR
Sediment	Generally a mixture of small boulders and cobble. Gravel, sand, and some silt contribute minimally to total substrate composition. Fine bed material is present in greater amounts in areas with multiple channels, debris dams, and beaver activity.	FAR	Generally a mixture of cobble, gravel, sand, and some silt with a preponderance of small cobble. Fine sediments most often are found in deep pools and behind debris and beaver dams.	FAR
Chemical contamination/nutrients	Historical contamination due to smelting operations has degraded water and sediment quality. Elevated levels of heavy metals are observed during high flows. Nutrient inputs from agricultural runoff appear minimal but may also be a potential issue.	FUR	Historical contamination due to smelting operations has degraded water and sediment quality. Elevated levels of heavy metals are observed during high flows. Loading of copper after rain events is highest in Reach 3a and Reach 3b. Nutrient inputs from agricultural runoff are minimal but likely higher than in Section 32 due to active farming along stream banks.	FUR
Physical barriers	Meyers Dam is a physical barrier for bull trout populations separating stable upstream populations from the Section 32 reach. However, this barrier has also limited brook trout and brown trout populations from expanding upstream. The two road crossings at the beginning and end of the project area are bridges that do not serve as fish barriers. The braided system may limit flow, decrease depth, and increase temperatures in the main channels, rendering habitat unsuitable. Debris dams and low flows through shallow riffle areas could also serve as physical barriers. Portions of this reach also contain ice dams, or have been observed to completely freeze over, thus impeding fish movements in winter.	FUR	Meyers Dam is a physical barrier for bull trout populations separating stable upstream populations from the Lower Warm Springs Creek reach. However, this barrier has also limited brook trout and brown trout populations from expanding upstream. If installed or maintained improperly, road culverts could also block fish movements. However, the four agricultural road crossings do not appear to be serving as barriers to fish movement.	FAR
Substrate embeddedness	Overall, field investigations indicate that sedimentation/siltation is a minor problem; therefore, embeddedness is likely low to moderate. Fine sediment is more common within the braided portion of the project area and behind debris and beaver dams. Sands and silts also tend to accumulate in areas of low velocity (i.e., deep pools). The smothering of suitable substrate and the extent of embedded substrate is likely higher in these areas.	FAR	Field investigations indicate that sedimentation/siltation is a minor problem; therefore, embeddedness is likely low to moderate. Fine sediment appears to be concentrated in the deepest pools and behind debris and beaver dams.	FA
Large woody debris	Limited large woody debris potential due to narrow forested riparian corridors. Some large cottonwoods present but very little debris observed within the majority of channel. However, high levels of beaver activity and debris dams have contributed to an excessive amount of localized woody debris accumulation within some portions of Section 32.	FAR	Limited large woody debris potential due to narrow forested riparian corridors. Some large cottonwoods present but woody vegetation dominated by smaller willow species. Large woody debris concentrated at sharp meander bends. Debris largely consists of uprooted willows; large logs largely absent.	FUR
Pool frequency and quality	Habitat indicators and field observations suggest that pools are primarily shallow scours and the braided system has reduced pool frequency, variability, and quality. However, several high-quality, large pools are present in the downstream portions of Section 32.	FUR	Sinuosity and varied sediment indicate that riffle-pool sequence is present. Large pools are fairly numerous and are largely located on the outside of meander bends. Fast-deep and slow-deep pools are most common. Some fine sediment deposition has reduced pool volume and some pools lack sufficient cover. Pool depth commonly enhanced by local scour at debris accumulations.	FAR
Large pools	Large pools are not as common as in Lower Warm Springs Creek due to braided system and lower sinuosity. Some large pools were noted at RM 7.4 during fish sampling. Other large pools were observed in the southern channel downstream of the braided reach, and in the reach below the confluence of the north and south channels.	FAR	Fairly high number of large pools present, especially at outside meander bends.	FA

Table 4-1 Matrix of Pathways and Indicators. Baseline indicators and documentation for bull trout in Warm Springs Creek –Lower Warm Springs Creek and Section 32 remediation areas (continued)

Indicator	Section 32 Values	Rating	Lower Warm Springs Creek Values	Rating
Off-channel habitat	Off-channel habitat has been heavily impacted by human activities, particularly the deposition of tailings deposits and contaminated sediments. The watershed has many backwaters and side-channels within a braided channel system and within the portion of the north and south main channels. Seasonal side channels tend to be low velocity due to debris dams, beaver activity, and the large quantity of channels present. Due to low bank heights and spatial/temporal variability in debris accumulations, side channels are inconsistently accessed and generally poorly formed. While off-channel habitat is present, many side channels are not large or deep enough to support adult fish.	FAR	Off-channel habitat has been heavily impacted by tailings deposits, agriculture, grazing, and Highway 48 to the south. Off-channel habitat largely consists of groundwater-fed willow flats; although, some small side channels and backwaters are present. Lower Warm Springs Creek contains fewer off-channel aquatic habitat features than Section 32. The proposed action aims to convert the existing channel into off-channel habitat in the form of a pond, oxbow, or wetland.	FUR
Refugia	Limited and few areas of sufficient size containing good habitat conditions. Water temperatures are generally too high to support bull trout year-round. Some habitat exists for migration and overwintering, but the distances between deep pools, debris and beaver dams, and long stretches of shallow riffles are impediments to fish movements. Spawning and rearing habitat is relatively absent.	FUR	Limited and few areas of sufficient size containing good habitat conditions. Water temperatures are generally too high to support bull trout year-round. More large pool (thermal refugia) habitat exists for migration and overwintering than in Section 32. Distances between shallow riffle stretches and deep pools are shorter than in Section 32 and provide relatively good connectivity. Large beaver dam may impede fish movement.	FAR
Wetted width/depth ratio	The braided section contains large width-to-depth ratios indicative of a D-type or D_A–type channel. Portions of the reference reach and downstream of the confluence of the north and south channels are more characteristic of a C-type channel with moderate to high width-to-depth ratios. The capacities of individual channels vary along their extents, such that bankfull flows locally exceed conveyance capacity of both the main channel and side channels. Bankfull flows are likely only maintained within the main channel for short periods and even shorter periods for side channels.	FUR	The Lower Warm Springs Creek reach largely contains a C-type channel with moderate to high (> 12) width-to-depth ratio.	FAR
Streambank condition	Banks near road crossings and other channelized areas tend to be steep and reinforced in order to promote stability. Banks within the braided system are low and locally unstable with recent evidence of channel migration. Banks are reinforced by dense root masses in areas of persistent floodplain sheetflow. There are very few areas of severe erosion due to the presence of mature trees and rocky substrate. Bank instability is largely due to recent channel erosion caused by shifting flow paths in the multi-thread system.	FAR	Some trampled banks are present where grazing is allowed. A few small areas have been straightened or armored with riprap to protect residences and agricultural interests and to direct flow to irrigation headgates. Banks are largely vegetated, but un-vegetated outer bends exhibit severe erosion.	FAR
Floodplain connectivity	Floodplain connectivity is relatively high throughout the braided portion of the reach. Connectivity is poor in areas with an entrenched channel and steep banks found near road crossings and in other channelized areas. The majority of the floodplain can be accessed during 10-year flood events. In some areas of debris accumulation, the main channel is overtopped at flows less than bankfull. However, overbank flows support few off-channel wetland habitats.	FAR	Despite significant alterations downstream, the Lower Warms Springs Creek reach has retained relatively high sinuosity and floodplain connectivity. Where the stream nears Highway 48, it has been channelized; the cross section becomes entrenched with areas of steep, high cut banks and the floodplain is disconnected at moderate events. However, the majority of the floodplain can be accessed during 10-year flood events. Off-channel willow flats appear to be supported by groundwater and not floodwaters.	FAR
Change in peak/base flows	Peak flows occur generally in May-June from snowmelt runoff. Flows are dramatically altered by upstream and within-reach irrigation withdrawals. Historical de-watering during irrigation seasons has occurred; however, recent in-stream flow agreements (2003-present) have resulted in fairly good summer base flows. The braided system reduces flow in the main channel and side channels often run dry. Within Section 32, the stream is perched tens of feet above the water table, precluding groundwater gains in the reach. The downstream USGS gage at Warm Springs indicates that the system loses 20-30% of its discharge compared to the gage located upstream of Gardiner Ditch.	FUR	Peak flows are generally in May-June from snowmelt runoff. Flows are dramatically altered by upstream and within-reach irrigation withdrawals. Historical de-watering during irrigation seasons has occurred; however, recent in-stream flow agreements (2003-present) have resulted in fairly good summer base flows. Despite being a gaining stream, the downstream USGS gage indicates that the system loses 20-30% of its discharge compared to the gage located upstream of Gardiner Ditch.	FAR
Drainage network increase	The development of Anaconda led to an increase in the drainage network. This increase has slowed as growth has slowed. Roadside ditches are present along nearby roads. Much of the surrounding land is still pervious and groundwater inputs contribute to streamflow. There is a small increase in active channel length due to human disturbance.	FAR	The development of Anaconda led to an increase in the drainage network. This increase has slowed as growth has slowed. Roadside ditches are present along Highway 48. Much of the surrounding land is still pervious and groundwater inputs contribute to streamflow. There is a small increase in active channel length due to human disturbance.	FAR
Road density and location	Road density is moderate, with Highway 48 to the south located within 400-1500 ft. of the stream along the entire reach. Section 32 is also bounded by Galen Rd. to the west and Mertzig Rd. to the east.	FAR	Road density is low, but Highway 48 to the south is within 200-1400 ft. of the stream along the entire reach.	FAR
Disturbance history	The disturbance history is based on adjacent roads, agricultural/grazing activities, and historical smelting operations within the watershed. Primary disturbances in Section 32 are a result of urbanization upstream and deposition of contaminants from historical smelting operations. Remediation on the adjacent floodplain has resulted in a lowering of that surface and relative perching of the main channel. The Section 32 reach is part of a USEPA Superfund Site.	FUR	Disturbance history is based on adjacent roads, agricultural/grazing activities, and historical smelting operations within the watershed. Primary disturbances in Lower Warm Springs Creek are associated with agricultural and grazing operations, stream channelization, and deposition of contaminants from historical smelting operations. Agricultural and grazing activities are more prevalent in this project area as compared to Section 32. The Lower Warm Springs Creek reach is part of a USEPA Superfund Site.	FUR

Table 4-1 Matrix of Pathways and Indicators. Baseline indicators and documentation for bull trout in Warm Springs Creek –Lower Warm Springs Creek and Section 32 remediation areas (continued)

Indicator	Section 32 Values	Rating	Lower Warm Springs Creek Values	Rating
Riparian conservation areas	The project aims to improve stream and riparian areas for conservation of bull trout and other wildlife. Riparian areas contain mature trees which provide stream shading and large woody debris (LWD) recruitment. However, riparian buffers tend to be narrow (< 30 feet). The majority of Section 32 is owned by Atlantic Richfield. No formal conservation areas are planned but grazing is restricted in the riparian area.	FAR	Ownership of the riparian areas could be an issue to establishing conservation areas. The project aims to improve stream and riparian areas for conservation of bull trout and other wildlife. Land use agreements, including grazing restrictions, are currently being negotiated. Riparian areas contain dense willow stands, but fewer mature trees than Section 32, which results in less stream shading and LWD recruitment. Riparian areas are wider along portions of the stream with no agriculture or grazing. Portions of the reach with active agriculture and grazing are degraded.	FAR
Disturbance regime	Due to the effects of historic smelting operations, large quantities of flood-deposited tailings composed of heavy metals are present throughout the project area. Causes of impairment identified by USEPA include flow alteration, substrate alteration, sedimentation/siltation, and a reduction in vegetative cover likely caused by agricultural activities. Frequent flooding and channel instability contribute to volatility. Contaminant removal from the adjacent floodplain has locally perched the main channel above the floodplain and increased disturbance potential via avulsion.	FUR	Due to the effects of historic smelting operations, large quantities of flood-deposited tailings composed of heavy metals are present throughout the project area. More removals are planned here than in Section 32 as floodplain remediation upstream is largely complete. Causes of impairment identified by USEPA include flow alteration, substrate alteration, sedimentation/siltation, and a reduction in vegetative cover likely caused by agricultural activities. Flooding and channel instability are a problem but not as frequent or to the extent of that seen in Section 32.	FUR
Integration of species and habitat conditions	The entire reach is at risk due to the isolation of bull trout from other potentially refounding populations, effects of past smelting operations in Anaconda, irrigation withdrawals, and the dominance of non-native species.	FUR	The entire reach is at risk due to the isolation of bull trout from other potentially refounding populations, effects of past smelting operations in Anaconda, irrigation withdrawals, and the dominance of non-native species.	FUR

Rating: FA = functioning appropriately; FAR = functioning at risk; FUR = functioning at unacceptable risk

The MPI analysis also contributes to the evaluation of potential project impacts to the nine Primary Constituent Elements (PCEs) of critical habitat for bull trout (USFWS 2013a). PCEs are a set of physical or biological features that the USFWS has defined as essential to the conservation of bull trout and may require special management consideration or protection (USFWS 2012a). PCEs for bull trout were determined from studies of their habitat requirements, life-history characteristics, and population biology. PCEs may include, but are not limited to, features such as spawning sites, feeding sites, and water quality or quantity. An area need not include all nine PCEs in order to qualify for designation as critical habitat (USFWS 2004). The nine PCEs are:

1. Springs, seeps, groundwater sources, and subsurface water connectivity to contribute to water quality and quantity;

2. Migratory corridors with minimal physical, biological, or chemical barriers between spawning, rearing, overwintering, and foraging habitats, including intermittent or season barriers induced by high water temperatures or low flows;

3. An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish;

4. Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures;

5. Water temperatures ranging from 2-15°C (36-59°F), with adequate thermal refugia available for temperatures at the upper end of this range. Specific temperatures within this range will vary depending on bull trout life history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influences;

6. Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine substrate less than 0.85 cm (0.03 in) in diameter and minimal substrate embeddedness are characteristic of these conditions;

7. A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, a hydrograph that demonstrates the ability to support bull trout populations

8. Permanent water having low levels of contaminants such that normal reproduction, growth, and survival are not inhibited; and

9. Few or no predatory, interbreeding, or competitive nonnative species present.

The key to understanding the potential effects to bull trout critical habitat is to analyze how the proposed actions would affect the nine PCEs. The 19 habitat indicators are correlated with the nine PCEs allowing a "crosswalk" between the PCEs and various indicators from the MPI. Having this agreed-upon framework which clearly identifies the connection between changes to MPI indicators and effects to PCEs facilitates interagency consensus, provides a clear basis for consistent decision-making, and streamlines the conference/consultation process (USFWS 2004).

Table 4-2 shows the relationship between the PCEs for bull trout critical habitat and the 19 MPI habitat indicators.

Table 4-2 MPI indicators relevant to each of the PCEs of proposed bull trout critical habitat (2010 version)

Diagnostic Pathway/ Indicator (i.e., 19 MPIs)	*PCE 1 - Springs, seeps, groundwater	PCE 2 - Migratory Habitats	PCE 3 - Abundant food base	PCE 4 - Complex habitats	PCE 5 - Water Temperature	PCE 6 - Substrate features	PCE 7 - Natural Hydrograph	PCE 8 - Water quality and quantity	PCE 9 - Predators competitors
Water Quality									
Temperature		X	X		X			X	
Sediment		X	X			X		X	
Chemical Contaminants and Nutrients	X	X	X					X	
Habitat Access									
Physical Barriers	X	X	X						X
Habitat Elements									
Substrate Embeddedness	X		X			X			
Large Woody Debris				X		X			
Pool Frequency and Quality			X	X		X			
Large Pools				X	X				
Off-Channel Habitat				X					
Refugia		X			X				X
Channel Conditions and Dynamics									
Wetted Width/ Maximum Depth Ratio		X		X	X				
Streambank Condition	X			X	X	X			
Floodplain Connectivity	X		X	X	X		X	X	
Flow/Hydrology									
Changes in Peak/Base Flows	X	X			X		X	X	
Drainage Network Increase	X						X	X	
Watershed Conditions									
Road Density and Location	X				X		X		
Disturbance History				X			X	X	X
Riparian Conservation Areas	X		X	X	X		X		
Disturbance Regime				X			X	X	

*Updated for 2010 proposed rule Khalupka 2-24-10 (USFWS 2013a)

USFWS supports efforts that allow for PCEs to become fully established. In a letter dated October 3, 2012, USFWS indicated that the removal of contaminants of concern from the floodplain of Warm Springs Creek is an important step for improving bull trout habitat and PCE function. In addition, USFWS supports the use of the proposed soft engineering approaches and efforts that allow the stream channel to move across the floodplain. Connected floodplains allow for the renewal of physical and biological interactions that support complex aquatic habitats important to bull trout (USFWS 2012a). While the final result of proposed stream improvements within the project areas are likely to enhance bull trout critical habitat, short-term construction activities could disturb individuals and existing habitats. Descriptions of how each of the PCEs could be affected by the project are provided in Section 4.2.

4.2 Discussion

The following paragraphs elaborate on the information provided in Table 4.1 and describe how the MPI indicators are related to evaluating the function of each PCE for bull trout habitat within the lower Warm Springs Creek corridor (USFWS 2013a). The 19 MPI indicators referred to in this section will appear in italicized text.

PCE 1 – Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flow) to contribute to water quality and quantity and provide thermal refugia.

The analysis of *floodplain connectivity* considers the hydrologic linkage of off-channel areas with the main channel and overbank-flow maintenance of wetland function and riparian vegetation and succession. Floodplain and riparian areas provide hydrologic connectivity for springs, seeps, groundwater upwelling, and wetlands and contribute to the maintenance of the water table. The analysis of *changes in peak/base flows* addresses subsurface water connectivity and *substrate embeddedness* addresses inter-gravel flows. *Increase in drainage network* and *road density and location* address potential changes to groundwater sources and subsurface water connectivity. *Streambank condition*, *floodplain connectivity*, and *riparian conservation areas* address groundwater influence. *Chemical contamination/nutrients* address concerns regarding groundwater water quality (USFWS 2013a).

While several MPI indicators contribute to the analysis, PCE 1 largely focuses on subsurface water connectivity through the evaluation of floodplain connectivity and changes in peak/base flows. Some of the additional indicators mentioned above are of little concern due to site conditions (i.e., *substrate embeddedness*), or are more applicable to other PCEs (i.e., *chemical contamination/nutrients*) and will be addressed in detail within those discussions.

<u>Section 32 Project Area</u>

Warm Springs Creek is generally disconnected from groundwater sources within Section 32. The stream is perched tens of feet above the water table, precluding groundwater gains in the reach. The lack of groundwater inputs magnifies the impacts of water withdrawals, particularly from Gardiner Ditch, and contributes to reduced flow and water depths. Shallow water depths likely prevent bull trout from using large portions of Section 32 for foraging, migratory, and overwintering habitat.

Existing floodplain connectivity within the Section 32 Project Area is functioning at risk. The majority of the floodplain can be accessed during 10-year flood events. Connectivity is relatively high throughout the braided portion of the reach and contributes to the presence of freshwater marsh. The floodplain connection is poor in areas with an entrenched channel and steep banks found near road crossings and in other channelized areas. Overall, the floodplain supports few off-channel wetland habitats, with the majority located within the braided system.

Proposed remedial actions are expected to have many positive effects on bull trout and bull trout habitat. Remedial actions should improve floodplain connectivity through the grading of streambanks; thereby allowing floodplain connection during 2-year flood events. Diverting the majority of stream flows back into the main channel would result in increased water quantity within that channel and would help offset the effects of upstream water withdrawals. This increase would increase overall water depths, which would enable bull trout to traverse this stream section more easily and could establish thermal refugia in the deeper pools.

Despite expected improvements to bull trout habitat from remedial actions, it is not expected that proposed actions will connect the stream to groundwater sources. The streambed is perched too high above groundwater sources to establish a connection without significant excavation. Such activities are beyond the scope and budget of planned remedial efforts. Therefore, water quality and quantity improvements would not come from reestablishing groundwater connections, but would instead be a result of streambank contaminant removal, increased floodplain connectivity, reestablishing majority flow in the main channel, and restricting grazing and other activities from riparian areas.

Lower Warm Springs Creek Project Area

Within the Lower Warm Springs Creek Project Area, Warm Springs Creek is a gaining stream with the channel largely located below the water table. Groundwater connections help maintain base flows during irrigation seasons and drought. Willow flats and wetland areas to the north of the channel are also largely groundwater-fed. Despite evidence of groundwater inputs, overall discharge decreases 20-30 percent between the Anaconda and Warm Springs USGS stream gages. The reduction in water quantity is due largely to irrigation diversions and side channels. Unlike in Section 32 where shallow water depths are common, Lower Warm Springs Creek contains good base flow and frequent deep pools. This is a result of flow largely being contained within a single channel with a high degree of sinuosity. Frequent, deep pools and suitable water depths are important components of bull trout foraging, migratory, and overwintering habitat.

Existing floodplain connectivity within the Lower Warm Springs Creek Project Area is functioning at risk. Despite significant alterations downstream, the stream has retained relatively high sinuosity and floodplain connectivity. Where the stream nears Highway 48, it has been channelized. The cross section becomes entrenched with areas of steep banks and the floodplain is disconnected at moderate flood events. However, the majority of the floodplain can still be accessed during 10-year flood events. Overall, the floodplain supports some off-channel habitats, largely consisting of willow flats with some side channels and backwaters also present. However, the floodplain has been heavily impacted by tailings deposits, agriculture, grazing, and Highway 48 to the south.

Within the Lower Warm Springs Creek Project Area, proposed remedial actions are not likely to have a significant impact on existing groundwater connections. Therefore, groundwater contributions to water quantity and quality should remain at existing levels. Remedial actions are expected to improve floodplain connectivity through streambank grading and stabilization measures associated with contaminant removal activities. This would promote floodplain connection during 2-year flood events. Remedial actions also propose to reestablish flows to the original channel; thereby converting the existing channel into off-channel backwater habitat.

Remedial actions should have no significant impact on existing deep pools and active groundwater connections that provide bull trout with adequate foraging, migratory, and overwintering habitat. During construction, contaminant removal, streambank stabilization, and re-establishing flow through the historic channel could result in temporary pulses of sediment within the water column. It is expected that these sediment increases would be flushed quickly downstream; therefore, impacts to water quality would be small and temporary. These initial short-term impacts are expected to be offset by long-term improvements in streambank condition and floodplain connectivity which are expected to improve water quality, riparian condition, and would provide off-channel habitat favoring recruitment of prey species.

PCE 2 -Migratory habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

Physical, biological or chemical barriers to migration are addressed directly through water quality habitat indicators, including temperature, sediment, chemical contamination/nutrients and physical barriers. The analysis of these indicators assess whether barriers have been created due to impacts such as high temperatures or high concentrations of turbidity or contaminants. Analysis of change in peak/base flows and average wetted width/maximum depth ratio assess whether changes in flow might create a seasonal barrier to migration. An analysis of refugia considers the habitat's ability to support strong, well distributed, and connected populations for all life stages and forms of bull trout (USFWS 2013a).

While several MPI indicators contribute to the analysis, PCE 2 largely focuses on barriers to bull trout movement through the evaluation of physical, chemical, and biological stream conditions. While temperature may be the most significant factor when determining bull trout presence, it is the sole focus in the discussion of PCE 5 below. Likewise, sediment is the focus of PCE 6. Therefore, the PCE 2 discussion will largely focus on chemical contamination/nutrients and physical barriers.

<u>Section 32 Project Area</u>

Meyers Dam, located upstream of Anaconda, is a physical barrier for bull trout populations separating stable upstream populations and optimal spawning/rearing habitat from the Section 32 reach (Figures 3-4 and 3-7). However, this barrier has also limited brook trout and brown trout populations from expanding upstream. There are no known plans to remove the dam at this time. The Galen Road and Mertzig Road bridge crossings at the beginning and end of the project area do not serve as barriers to bull trout movement. The main physical barriers within Section 32 result in permanent or seasonal low flow conditions. The braided channel system limits flow, decreases depth, and increases temperatures within the main channels, rendering habitat unsuitable. The majority of Section 32 contains large width-to-depth ratios and bankfull flows are likely only maintained within main channels for short periods. These width-to-depth ratios are characteristic of wide, shallow riffles, which may be difficult for bull trout to traverse, particularly during low flows. Debris dams and beaver activity are also widespread throughout Section 32 and serve as physical barriers when they span the entire channel. In the winter, portions of this reach also contain ice dams or have been observed to completely freeze over, thus restricting fish movements.

Historical contamination due to smelting operations has degraded water quality and sediment quality. Elevated levels of heavy metals, particularly copper, are observed during high flows. Within Section

32, significant quantities of contaminated sediment have already been removed from the floodplain and nutrient inputs from agricultural runoff appear to be minimal.

One of the primary goals of the remedial actions is to remove debris dams and reduce the impact of beaver activity for flood control purposes. Debris and beaver dam removal would prevent water from backing up and would promote the flushing of debris and fine sediment through the system. Removal of these dams should provide bull trout with access to portions of the stream that were once cut-off. Proposed remedial actions would also divert flow from the braided channel system back into the main channel. Re-establishing the main channel as the primary watercourse would initiate the transition from a braided D-type channel system with high width-to-depth ratios to a single, C-type channel with more moderate width-to-depth ratios. This would increase flows and water depths within the main channel, allowing bull trout to traverse these stream reaches more easily. The removal of debris and the changes in water quantity and channel morphology would also lessen the likelihood of ice dams and complete freezing.

While the removal of debris dams and beavers from the project area is expected to have several positive impacts on bull trout and bull trout habitat, it would also likely reduce off-channel stream and wetland habitat. The freshwater marsh supported by the braided channel system and beaver activity will likely transition to a drier plant community once water is diverted. To the east of the braided section, the north channel (**Figure 2-3**), which now conveys 50 percent of stream flows, will likely revert back to an ephemeral system. While the north channel does not contain optimal bull trout habitat, any bull trout there would be displaced and would have to compete with resident fish present within the main south channel. Additionally, debris removal activities are focused on flood control objectives. The remediated system would reduce the quantity of large woody debris, which bull trout often rely on for cover.

While contamination removal activities in Section 32 have largely been completed, pocket removals are still planned. The removal of these remaining hotspots is expected to reduce the levels of heavy metals within the stream; thereby improving water quality to the benefit of the local aquatic community.

Lower Warm Springs Creek

As mentioned previously, Meyers Dam is the primary physical barrier separating Lower Warm Springs Creek from relatively sustainable bull trout populations and optimal bull trout habitat. Within the Lower Warm Springs Creek project area there are four small agricultural road crossings, but none appear to be barriers to fish passage. The main physical barriers within Lower Warm Springs Creek are occasional long stretches of shallow riffles between meander bends and large beaver and debris dams. The majority of Lower Warm Springs Creek contains moderate width-to-depth ratios typical of a C-type channel that should not impede fish movement during normal flow conditions. Unlike Section 32, most of Lower Warm Springs Creek freezes from the top down; therefore, the water surface may be frozen over but water still flows freely beneath the ice. The presence of large pools at meander bends also provide thermal refuge to fish during winter months.

Historical contamination due to smelting operations has degraded water quality and sediment quality. Elevated levels of heavy metals, particularly copper, are observed during high flows. When compared with Section 32, Lower Warm Springs Creek still possesses significant quantities of contaminated sediment within the floodplain, which makes its way into the stream through erosion and flood events.

Nutrient inputs from agricultural runoff appear to be minimal; however, are likely higher than in Section 32 which contains fewer active agricultural operations.

Debris and beaver dam removal activities are planned to reduce flood potential and promote the flushing of debris and fine sediment through the system. Removal of these dams should provide bull trout with access to portions of the stream that were once cut-off. While the removal of debris dams and beavers from the project area is expected to facilitate fish movement, debris removal activities are largely focused on flood control objectives. The remediated system would reduce the quantity of large woody debris, which bull trout often rely on for cover. In areas where large boulders provide sufficient in-stream cover, there may minimal effect on bull trout, but in areas where large woody debris provides the only in-stream structure, removal may render those stream reaches unsuitable for foraging and overwintering habitat.

Remedial actions would also remove large quantities of contaminated sediment from streambanks and floodplains, thereby improving water quality. Small amounts of sediment are expected to enter the stream during contaminant removal and bank re-construction activities, but planned construction methods and BMPs are expected to minimize sediment inputs into the channel.

Construction access would include several stream crossings involving the use of culverts. If not installed properly, these culverts could become barriers to fish movement. Culverts should be installed to ensure that they do not create high-flow, shallow-water, or steep-gradient conditions that fish cannot easily traverse.

Remedial actions also propose to divert flow from a portion of the existing channel back into the historic, abandoned channel to the north. To accomplish this, permanent plugs consisting of natural fill would be used to redirect flows. These plugs would create barriers to fish movement; however, they would redirect fish to the main channel and prevent access to impounded, isolated habitats. At the completion of construction, the existing channel would be entirely cut off from the main channel to form off-channel pond or wetland habitat, which could initially entrap bull trout individuals. Initial entrapment of bull trout during construction can be mitigated with a USFWS-approved catch and transport program.

PCE 3 -An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Floodplain connectivity and riparian conservation areas provide habitat to aquatic invertebrates, which in turn provide a forage base for bull trout. Pool frequency and quality and substrate embeddedness contributes to the variety and density of aquatic invertebrates and other fish species. Changes in temperature, sediment, and chemical contamination and nutrients affect aquatic invertebrate production. Therefore, the combined analyses of all the MPIs and the other PCEs will assist in determining whether there is an abundant food base in the analysis area (USFWS 2013a).

While several MPIs contribute to the analysis, PCE 3 largely focuses on the ability of in-stream and riparian habitats to provide bull trout with an abundant food base. Water temperature and sediment will be discussed in depth in PCE 5 and PCE 6, respectively. Floodplain connectivity (PCE 1) and chemical contamination and nutrients (PCE 2) were discussed in previous sections. Therefore, the PCE 3 discussion will largely focus on pool frequency and quality, substrate embeddedness, and riparian conservation areas.

Bull trout at different life stages tend to seek out different food sources. Bull trout fry largely feed on benthic and near benthic aquatic insects, zooplankton, and crustaceans (Fish 2004). Juvenile bull trout and small adults consume terrestrial and aquatic insects, macro-zooplankton, amphipods, mysids, crayfish, and small fish. As they grow larger, adult bull trout transition to feeding almost entirely on fish, including whitefish, sculpin, shiners, suckers, and other trout (Fraley and Shepard 1989; Donald and Alger 1993). Since the section of Warm Springs Creek flowing through the two project areas is designated as FMO habitat, the focus of this discussion will be on juvenile and adult bull trout food sources.

In a 2012 benthic macroinvertebrate bioassessment evaluation of the Upper Clark Fork River Basin, two assessment points were located on Warm Springs Creek. The first, WSC-1, was located at the I-90 bridge, just upstream of the confluence with the Upper Clark Fork River. The second, WSC-2, was located at the Red Sands Road bridge crossing, approximately 1.25 miles upstream of Galen Road (AECOM 2013).

Table 4-3 Relative Abundance of Taxa Present in EPA and MDEQ samples from Warm Springs Creek Sites (AECOM 2013)

	WCS-1		*WCS-2*	
Taxa	**EPA**	**MDEQ**	**EPA**	**MDEQ**
Acari			0.08%	
Bivalvia			0.03%	
Coleoptera	1.0%	1.3%	9.5%	17.8%
Diptera	16.5%	15.5%	34.1%	38.5%
Ephemeroptera	41.5%	49.3%	21.6%	19.5%
Isopoda	0.08%			
Nematoda	0.21%		0.10%	
Oligochaeta	7.1%	9.6%	3.6%	3.2%
Plecoptera	3.8%	5.4%	3.4%	0.08%
Trichoptera	28.8%	18.0%	27.6%	21.0%
Triciadium	0.89%	1.0%		
Total	**100%**	**100%**	**100%**	**100%**

The relative abundance of benthic macroinvertebate taxa present at both Warm Springs Creek sampling locations is provided in **Table 4-3**. Results show that in the lower reaches of Warm Springs Creek (WSC-1), the macroinvertebrate community is dominated by mayflies [Ephemeroptera (~45%)], caddisflies [Trichoptera (~23%)], and true flies [Diptera (~16%)], with smaller populations of worms (Oligochaeta) and stoneflies (Plecoptera) also present. Upstream of Galen Road (WSC-2), relative abundance changed slightly with true flies becoming the dominant group (~36%), followed by caddisflies (~24%) and mayflies (~21%). Beetles [Coleoptera (~14%)] also made up a significant proportion of the macroinvertebrate community, while worms and stoneflies were less common than in WSC-1 samples (AECOM 2013).

Mayflies, stoneflies, and caddisflies, collectively known as EPT taxa, are relatively intolerant species and are regarded as indicators of good water quality. True flies, beetles, and worms are generally more tolerant; therefore, are often regarded as indicators that water quality impairments and/or habitat degradation may be present. At both sampling sites, Warm Springs Creek appears to have benthic communities dominated by EPT taxa. While the upstream sampling site contains a greater proportion of tolerant organisms, both achieved the highest biointegrity/bioassessment from the EPA ("unimpaired") and MDEQ ("slightly impaired") indices (AECOM 2013). The presence of healthy macroinvertebrate populations provides bull trout with a healthy forage base. This is particularly true of juvenile bull trout which, in the Flathead Basin, have been known to prefer true flies and mayflies (Hammond 2004).

While they are also known to feed on aquatic insects, adult bull trout are largely piscivorous. Fish sampling events in 2007 recorded the presence of large populations of other trout species, particularly brown trout, at three locations within or adjacent to project areas (Montana FWP 2008). Lower reaches of Warm Springs Creek are noted brown trout spawning areas; therefore, small brown trout would provide large bull trout with a forage base. In addition to other trout species, Montana FWP waterbody reports also document resident populations of slimy sculpin, mountain whitefish, and longnose sucker in Warm Springs Creek.

<u>Section 32 Project Area</u>

Confirmed presence of healthy populations of benthic macroinvertebrates and forage fish upstream and downstream of Section 32 makes it highly likely that an adequate forage base is also present within the project area. Substrate within the majority of the Section 32 Project Area is composed primarily of small boulders and cobbles. Fine bed material is present in greater amounts in areas with multiple channels, debris dams, and beaver activity. Overall, field investigations indicate that sedimentation and siltation are minor problems. Large sediments exhibit a low degree of embeddedness (< 25%) and sands and silts were only found to accumulate in areas of low velocity (i.e., deep pools). The smothering of suitable substrate and the extent of embedded substrate are likely higher in these areas. Overall, large, slightly embedded substrate is typical and provides optimal habitat for EPT taxa and other macrobenthos on which bull trout feed.

Habitat indicators and field observations suggest that pools within Section 32 are primarily shallow scours. The braided channel system has reduced pool frequency, variability, and quality. However, several high-quality, large pools are present in portions of the reach downstream of the braided section. Pool variation supports a wider diversity of food sources; therefore, the food base in single-channel portions of Section 32 is likely more robust and stable than the food base within the braided system. Due to habitat conditions, the food base within the braided system is likely dependent on terrestrial insects.

Riparian areas contain mature trees which provide stream shading, large woody debris, and leaf litter. However, the majority of riparian buffers tend to be narrow (< 30 feet). Significant erosion is relatively absent; with dense root masses and rocky substrate contributing to relatively stable banks. Riparian areas within the braided section tend to support more shrubs and herbaceous species. Banks also tend to be relatively unstable due to shifting flow paths. Riparian habitats within Section 32 likely provide adequate amounts of organic material to sustain aquatic insects and shoreline vegetation which support terrestrial insects. However, widening or at least maintaining quality riparian buffers would likely lead to an improved forage base.

Proposed remedial actions within Section 32 are unlikely to increase embeddedness. Small, temporary increases in fine sediment associated with construction activities are possible, but are not expected to accumulate in significant amounts. Diverting flow from the multiple channel system to the main channel would reduce some wetland foraging areas and may slightly reduce access to terrestrial insects. However, the small channels within the braided system do not contain optimal bull trout habitat and are likely avoided by resident individuals. Overall, improvements to floodplain connectivity, streambank stability, riparian condition, and in-stream flows and depths outlined previously for bull trout would also have positive impacts on other prey species.

Lower Warm Springs Creek Project Area

As mentioned for Section 32, healthy populations of benthic macroinvertebrates and forage fish upstream and downstream of Lower Warm Springs Creek make it highly likely that an adequate forage base is also present within the project area. Substrate within the majority of the project area is composed primarily of small cobbles. Fine bed material is most often found in deep pools and behind debris and beaver dams. Overall, field investigations indicate that sedimentation and siltation are minor problems. Large sediments exhibit a low degree of embeddedness (< 25%). Overall, slightly embedded cobbles are typical and provide optimal habitat for EPT taxa and other macrobenthos on which bull trout feed.

Habitat indicators and field observations suggest that a well-developed riffle-pool sequence is present throughout Lower Warm Springs Creek. Large pools are numerous, particularly on outside meander bends. Pools contain a variety of velocity and depth combinations, with fast-deep and slow-deep pools being the most common. In some pools, fine sediment deposition has reduced pool volume and others lack sufficient cover. The riffle-pool sequences and frequency and variability of pools provide optimal habitat for a wide diversity of bull trout food sources.

Riparian areas contain fewer large, mature trees than found in Section 32; however, dense willow flats are common and provide stream shading, bank stability, and organic matter. Overhanging vegetation is plentiful and likely provides fish with a steady source of terrestrial insects. Riparian buffers are wider and are of higher quality along portions of the stream with no active agriculture or grazing. Significant erosion is common along outer meanders and denuded banks. However, sediment deposition is rare outside of deep pools. Riparian habitats within Lower Warm Springs Creek likely provide adequate amounts of organic material to sustain aquatic insects and shoreline vegetation which support terrestrial insects. However, widening or at least maintaining quality riparian buffers would likely lead to an improved forage base.

Proposed remedial actions within Lower Warm Springs Creek are unlikely to increase embeddedness to a point where interstitial spaces are clogged and aquatic insects smothered. Temporary increases in fine sediment associated with contaminant removal, bank stabilization, and flow diversion activities are possible, but are not expected to be significant. Diverting flow from the existing channel to the historic channel and creating off-channel wetland habitats would likely increase wetland foraging areas and may increase access to terrestrial insects. However, it may take a few seasons before aquatic insects colonize the historic channel at a density equal to the existing condition. During this time, bull trout would likely move upstream or downstream of the remediated reach to forage. Overall, improvements to floodplain connectivity, streambank stability, riparian condition, and in-stream flows and depths outlined previously for bull trout would also have positive impacts on other prey species.

PCE 4 - Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes with features such as large wood, side channels, pools, undercut banks and substrates, to provide a variety of depths, gradients, velocities, and structure.

Large woody debris (LWD) increases channel complexity and creates pools and undercut banks, so the analysis of the current amounts and sources of *large woody debris* available for recruitment is pertinent to this PCE. *Pool frequency and quality* considers the number of pools per mile as well as the amount of cover and temperature of water in the pools. *Average wetted width/maximum depth ratio* is an indicator of channel shape and pool quality. Low ratios suggest deeper, higher quality pools. *Large pools,* consisting of a wide range of water depths, velocities, substrates and cover, are typical of high quality habitat and are a key component of channel complexity. Analysis of *off-channel habitat* describes side-channels and other off-channel areas. *Streambank condition* analyzes the stability of the banks, including features such as undercut banks. The analysis of *riparian conservation areas,* and *floodplain connectivity, disturbance history, and disturbance regime* includes the maintenance of habitat and channel complexity, the recruitment of large woody debris, and the connectivity to off-channel habitats or side channels. Complex habitats provide refugia for bull trout; therefore, analysis of the MPI indicator *refugia* assesses stream channel complexity. All of these habitat indicators consider the numerous characteristics of in-stream bull trout habitat and quantify critical components that are fundamental to creating and maintaining complex in-stream habitat over time (USFWS 2013a).

<u>Section 32 Project Area</u>

Within Section 32, there is a high degree of channel complexity due to the presence of a braided, alluvial fan system and numerous secondary side channels. While this complexity increases the amount of off-channel wetland habitat, it also promotes sediment deposition, debris accumulation, bank instability, and a significant increase in width-to-depth ratios which is an indicator of poor water depth. The proposed remedial actions seek to divert flows back into main channels to improve sediment transport, water depths, channel integrity, and bank stabilization. While this may decrease overall channel complexity, it is expected to increase habitat conditions favorable to bull trout. This includes providing adequate base flows, stable streambanks, active floodplain connections, and large pools. Land use restrictions in riparian areas would maintain and conserve habitat quality and complexity.

In the existing condition, LWD is naturally limited within the Section 32 Project Area due to narrow forested riparian corridors. However, it has accumulated in several locations due to natural choke points and beaver activity. This accumulation has contributed to the diversion of flow out of the main channels and into side channels. Accumulations of LWD are often cited as causing the build-up of ice and debris dams which result in localized flooding. As mentioned in discussions on previous PCEs, one of the goals of the proposed remedial actions is to remove debris from stream channels and to limit future LWD for flood control purposes. The expected decrease in LWD would remove in-stream structure and cover preferred by bull trout. In areas with large boulders, undercut banks, or other sufficient cover, the impact of less LWD would be minimal. However, in many areas, LWD provides the only cover present and its removal and future absence may render these stream reaches unsuitable for bull trout.

Pool frequency and quality was discussed in detail for PCE 3. Portions of Section 32 upstream of and including the braided system suffer from a lack of large, deep pools. It is expected that the proposed remedial actions would increase pool frequency and quality by redirecting flows back to the main channel. In-stream construction activities would include scouring the streambed to different depths to increase pool microhabitat. Portions of Section 32 downstream of the braided system contain more typical riffle/pool sequences containing a greater number of large, deep pools. Pools in these areas may gain depth from increased flow, but would largely be unaffected by proposed remedial actions.

Lower Warm Springs Creek Project Area

Lower Warm Springs Creek does not contain multiple channel types like Section 32. Lower Warm Springs Creek largely contains a C-type channel with a moderate to high width-to-depth ratio. However, the project area still possesses a high degree of channel complexity due to the presence of established riffle/pool sequences. These sequences provide a wide variety of velocity-depth combinations which support a wide range of aquatic habitats. This habitat heterogeneity provides bull trout with access to a variety of food sources, thermal refugia, and cover.

In comparison to Section 32, Lower Warm Springs Creek contains large stretches of undercut banks created by scouring beneath dense root masses. Bull trout will often use undercut banks for cover and are considered components of optimal bull trout habitat. Remedial actions and bank reconstruction would remove a significant portion of existing undercut banks, thereby degrading bull trout habitat in the short-term. However, long-term bank stability and shallower bank slopes would improve water quality, create productive shallow-water habitats, and would replace undercut bank habitat with in-channel structure provided by willow plantings.

LWD is not as prevalent in Lower Warm Springs Creek because riparian areas within that project area are dominated by smaller willows. Where it is present, LWD tends to accumulate at tight meander bends and beaver dams. Debris consists largely of uprooted willows with large logs being generally absent. As mentioned in discussions on previous PCEs, goals of the proposed remedial actions include removing debris from stream channels and limiting future LWD for flood control purposes. The expected decrease in LWD would remove in-stream structure and cover preferred by bull trout. In areas with large boulders, undercut banks, or other sufficient cover, the impact of less LWD would be minimal. However, in many areas, LWD provides the only cover and its removal could result in these stream reaches becoming unsuitable for bull trout.

Pool frequency and quality was discussed in detail for PCE 3. Lower Warm Springs Creek, in particular, has a variety of pool types and a high frequency of large, deep pools that provide bull trout with cover and thermal refuge. It is not expected that the proposed remedial actions would have an adverse impact on these existing pools. It is likely that the proposed remedial actions would increase pool frequency and quality by scouring the streambed within the new channel to different depths to increase pool microhabitat.

Diverting flows back into the historic channel would transform the existing channel into an off-channel pond or wetland habitat. This off-channel habitat would be connected to the main channel during flood events and could provide expanded foraging opportunities for bull trout when accessible.

PCE 5 - Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures at the upper end of this range. Specific temperatures within this range will vary depending on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shade, such as that provided by riparian habitat; and local groundwater influence.

This PCE is addressed directly by the analysis of temperature. It is also addressed through consideration of refugia, which by definition is high quality habitat of appropriate temperature.

Availability of *refugia* also considers *pool frequency and quality* and the number of *large pools*. Average *wetted width/maximum depth ratio* is an indication of water volume, which indirectly indicates water temperature (i.e., low ratios indicate deeper water) which in turn indicates possible refugia. This indicator in conjunction with *change in peak/base flows* is an indicator of potential temperature and refugia concerns particularly during low flow periods. *Streambank condition, floodplain connectivity, road density and location* and *riparian conservation areas* address the components of shade and groundwater influence, both of which are important factors of water temperature. Stable streambanks and intact riparian areas, which include part of the floodplain, typically support adequate vegetation to maintain thermal cover to streams during low flow periods. *Road density and location* addresses the potential contributions of warm water discharges from stormwater ponds (USFWS 2013a).

While several MPI indicators contribute to the analysis, PCE 5 largely focuses on the temperature indicator because of the sensitivity of bull trout to extreme water temperatures (i.e., above 15 °C or below 2 °C). Groundwater inputs and floodplain connectivity influence water temperatures and are discussed in PCE 1. Pool frequency and quality and the presence of large pools are largely discussed in PCEs 3 and 4. Riparian areas are also discussed in PCE 3. Therefore, the PCE 5 discussion will largely focus on existing water temperatures and how proposed remedial actions may affect them.

The USGS stream gage at Warm Springs indicates that monthly mean temperatures from the years 2000-2012 all fall below the 15°C bull trout suitability threshold, with July recording the highest mean temperature of 14.6°C. However, daily mean maximum temperatures routinely exceed the suitability threshold (i.e., 15°C) beginning in mid-June and ending in early September. These daily maximum temperatures are often recorded during the afternoon hours, and resident bull trout would likely retire to cooler, deep pools during the heat of the day. Thermal refugia, including pools, undercut banks, and in-stream structure (e.g., boulders, LWD) help bull trout avoid heat stress during times when temperatures exceed 15°C.

<u>Section 32 Project Area</u>

Temperature data from USGS stream gages and sampling events upstream and downstream of Section 32 indicate that for most of the year, water temperatures are within the bull trout's preferred range (i.e., between 2 °C and 15 °C). However, in the summer, daily maximum temperatures frequently exceed the 15°C bull trout suitability threshold. In addition, during the winter, portions of Section 32 have been known to completely freeze over. Without suitable thermal refugia, bull trout within the project area may suffer from heat stress or cold stress brought on by unsuitable water temperatures.

The proposed remedial actions would divert flows back to the main channel; thereby increasing average base flows and water depths within the channel. The increase in water volume is expected to raise pool depths an average of 1-2 feet. These increases would help moderate extreme high and low water temperatures, particularly in times of low flow. It is important to note that proposed actions would not create many new pool habitats or thermal refugia but would likely enhance existing ones. However, increased flows could eventually create new scour pools and undercut bank habitats. Shallow side channels would largely be abandoned, but these channels lack suitable water depths or other thermal refugia when water temperatures are unsuitable for bull trout.

Road density and location are not expected to change as a result of the proposed remediation; therefore, effects of roads on water temperature should remain unchanged.

Grazing and other land use restrictions would protect riparian areas from degradation. The re-routing of flows away from the braided system would likely benefit large, mature trees within the riparian area, which would keep the main stream channel well shaded. Shaded stream sections provide thermal refugia to bull trout. The re-establishment of historical flow patterns to the main channel may also promote the growth of large tree species.

Lower Warm Springs Creek Project Area

Water temperatures in Lower Warm Springs Creek are assumed to be similar to those recorded at USGS stream gages and sampling events upstream and downstream of the project area. They indicate that for most of the year, water temperatures are within the bull trout's preferred range of 2 °C to 15 °C. However, in the summer, daily maximum temperatures frequently exceed the 15°C bull trout suitability threshold. Unlike Section 32, Lower Warm Springs Creek does not appear to completely freeze solid, with water flowing underneath the layer of surface ice. However, without suitable thermal refugia, bull trout within the project area may suffer from heat stress or cold stress brought on by unsuitable water temperatures.

Increases in water volume may be realized from proposed remedial actions planned upstream in Section 32. The effects of these increases on Lower Warm Springs Creek would likely be similar to those described for Section 32 in the previous section.

Proposed remedial actions would divert flows from the existing channel to the historic channel. The historic channel would be extensively excavated and graded to create what is essentially a new channel. During construction, operators have been informed to excavate the streambed irregularly to create scour pool habitats. However, no deep pools are planned. Therefore, there could be a loss of thermal refugia when transitioning from the existing to the historic channel. Additionally, the reconstruction of the historic channel would remove most of the existing vegetation from streambanks. While banks would be reinforced and planted with new vegetation, initially, water temperatures could increase due to a lack of stream shading. The grading, stabilization, and planting of eroded and denuded streambanks in other project areas would contribute to future thermal cover to the stream.

Road density and location are not expected to change as a result of the proposed remediation; therefore, effects on water temperature should remain unchanged. Grazing and other land use restrictions would protect riparian areas from degradation. The dense willow thickets that typically line stream banks within the project area would provide stream shading and thermal refugia to bull trout.

PCE 6 -Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount (e.g., less than 12 percent) of fine substrate less than 0.85 mm (0.03 in.) in diameter and minimal embeddedness of these fines in larger substrates are characteristic of these conditions.

The analyses for *sediment* and *substrate embeddedness* assess substrate composition and stability in relation to the various life stages of the bull trout as well as the sediment transportation and deposition. *Large woody debris* and *pool frequency and quality* affect sediment transport and redistribution within a stream and assessment of these indicators will clarify substrate composition and amounts. Analysis of *streambank condition* will provide insight into the amount of fine sediment contribution (USFWS 2013a).

While several MPI indicators contribute to the analysis, PCE 6 largely focuses on how sediment, embeddedness, and bank condition relate to bull trout success and survival. Several contributing indicators, including embeddedness (PCE 3), pool frequency and quality (PCEs 3 and 4), and large woody debris (PCE 4), have been discussed in detail for previous PCEs.

In addition, this PCE often focuses on spawning and rearing conditions; however, the lower reaches of Warm Springs Creek are designated as only FMO habitat. Therefore, the PCE 6 discussion will focus on the effects remedial actions may have on sediment in relation to juvenile and adult bull trout.

Section 32 Project Area

The substrate within the Section 32 Project Area is generally composed of a mixture of small boulders and cobble. Gravel, sand, and some silt contribute minimally to total substrate composition. Fine bed material is present in greater amounts in areas with multiple channels, debris dams, and beaver activity. Due to a relative lack of fine sediment embeddedness and sediment deposition is low and is largely restricted to low-velocity areas like deep pools, backwaters, and side channels. Turbidity levels are extremely low and the water is clear with no visible signs of contamination.

Streambanks near road crossings and other channelized areas tend to be steep and reinforced in order to promote stability. Banks within the braided system are low and locally unstable with recent evidence of channel migration. All banks are largely vegetated and are reinforced by dense root masses in areas of persistent floodplain sheetflow. There are very few areas of severe erosion due to the presence of mature trees and rocky substrate. Bank instability and resulting sediment contributions are largely due to shifting flow paths in the multi-channel system.

Within Section 32, the braided stream portion is the source of most of the sedimentation and the site of much of the sediment deposition. This is largely due to frequent, shifting flow paths and the creation and abandonment of side channels within this section. Proposed remedial actions would divert flow from the braided portion of the reach to the main channel to the south. This shift would eliminate sediment inputs from the braided section and would improve sediment transport through the main channel. The increase in volume through the main channel will likely result in some bank scour initially; however, the sediment increase is expected to be small and temporary.

Proposed remedial actions are not expected to change the composition of substrate. Therefore, substrate will likely continue to be dominated by small boulders and cobbles with minimal amounts of fine sediment and low levels of embeddedness. These substrate conditions are preferred by juvenile and adult bull trout and are sufficient to promote success and survival.

Lower Warm Springs Creek Project Area

The substrate within the Lower Warm Springs Creek Project Area is generally composed of a mixture of cobble, gravel, sand, and some silt with a preponderance of small cobble. Fine sediments are primarily sand-sized with smaller particles contributing little to overall substrate composition. They are most often found in deep pools and behind debris and beaver dams. Like Section 32, turbidity levels are extremely low, and the water is clear with no visible signs of contamination.

Streambanks are generally 4-5 feet in height and drop rather steeply to the stream channel. Some trampled banks are present where grazing is allowed. A few small areas have been straightened or armored with riprap to protect residences and agricultural interests and to direct flow to irrigation headgates. Banks are largely vegetated, with dense willow stands providing the majority of bank stabilization. Bank instability and severe erosion are largely restricted to un-vegetated banks on outer bends and near human development.

Contaminant removals will likely contribute small amounts of fine sediment to the stream. Proposed contaminant removal activities would leave a 5-foot wide section of streambank nearest the channel untouched while removal activities are conducted behind this buffer. Bank reconstruction and stabilization activities would involve grading, armoring, and planting techniques. Some sediment may enter the stream during high flows while planted vegetation takes root and matures. Overall sediment contributions from construction activities are expected to be small and temporary in nature.

Diverting stream flow from the existing channel to the historic channel may also result in sediment inputs, especially during the initial pulse of water through the historic channel. Initial plans call for cobble substrate from the historic and existing channels to be cleaned and placed into the historic channel, creating a new streambed with little fine sediment. Cobble material will be generated from over excavating the historic channel to the design subgrade along with harvesting material from the existing channel once abandoned. Fines will be removed using onsite screening equipment (e.g., grizzly screens). However, residual fines within the historic channel and fines scoured from lower banks during initial flows will likely become suspended in the water column. Due to construction methods, BMPs, and mitigation measures outlined in Sections 2 and 5, the overall impact of these small, temporary increases in turbidity on bull trout is expected to be minimal and concentrated during the initial water diversion.

PCE 7 -A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, they minimize departures from a natural hydrograph.

The analysis of *change in peak/base flows* considers changes in hydrograph amplitude or timing with respect to watershed size, geology, and geography. Analyses of *floodplain connectivity*, *increase in drainage network, road density and location, disturbance history,* and *riparian conservation areas* provides further information regarding possible interruptions in the natural stream hydrology. *Floodplain connectivity* considers the hydrologic linkage of off-channel areas with the main channel. Roads and vegetation management both have effects strongly linked to a stream's hydrograph. *Disturbance regime* ties this information together to consider how a watershed reacts to disturbance and the time required to recover back to pre-disturbance conditions (USFWS 2013a).

In the lower reaches of Warm Springs Creek, including both project areas, peak flows generally occur in May or June from snowmelt runoff. Flows are dramatically altered by upstream and within-reach water withdrawals. Historical de-watering during irrigation seasons has occurred; however, recent in-stream flow agreements (2003-present) have resulted in fairly consistent summer base flows. USGS stream gages located upstream of Gardiner Ditch and downstream at Warm Springs indicate that the system loses 20-30 percent of its total discharge over that span, largely to irrigation diversions and side channels.

The development of Anaconda led to an increase in the drainage network. This increase has slowed as growth has slowed. While the majority of the watershed is still pervious, there is a small increase in active channel length due to human disturbance.

Due to effects of historic smelting operations, large quantities of flood-deposited tailings composed of heavy metals are present throughout the two project areas. Significant contaminant removal operations have already been completed in Section 32, and are a component of proposed remedial actions for Lower Warm Springs Creek. The disturbance regime also consists of flow alteration, substrate alteration, sedimentation, and a reduction in vegetative cover in active agricultural areas. Frequent flooding and channel instability contribute to the system's volatility, especially in Section 32.

Section 32 Project Area

Within Section 32, remediation of the adjacent floodplain has resulted in a lowering of that surface and relative perching of the main channel. The channel is perched tens of feet above the water table, precluding groundwater gains in the reach. Compared to Lower Warm Springs Creek, which receives groundwater inputs, base flows in Section 32 are more variable. While base flows are generally maintained within main channel, the braided portion of the project area reduces flow to the main channel and side channels often run dry. Floodplain connectivity also influences base flows as discussed in detail previously for PCE 1.

The proposed remedial actions would divert flows from the braided channel system into the main channel. The increase in volume should stabilize base flows within the main channel. Returning the system to a natural hydrograph would decrease water flow and depth related impediments to fish movement. Natural flow patterns may also prevent portions of Section 32 from freezing completely in the winter. Despite these benefits, the main cause of Warm Springs Creek's altered hydrograph is irrigation withdrawals, which will remain in place.

Road density is relatively low, with Highway 48 paralleling the stream channel throughout the reach approximately 400-1500 feet to the south. Section 32 is also bounded by Galen Road to the west and Mertzig Road to the east. These roads do not appear to be influencing stream hydrology. Proposed remedial activities do not involve roadwork or the construction of permanent new roads; therefore, no impacts from roads on bull trout or bull trout habitat are expected.

Lower Warm Springs Creek Project Area

In comparison to Section 32, Lower Warm Springs Creek possesses hydrology typical of a valley stream. In a portion of the project area, flows would be diverted from the existing channel to the historic channel. While the watercourse would be altered, water quantity and quality are not expected to change relative the existing condition. In the short-term, bull trout may be trapped in the newly disconnected existing channel, but long-term impacts to bull trout and bull trout habitat are unlikely.

Road density is relatively low, with Highway 48 paralleling the stream channel throughout the reach approximately 200-1400 feet to the south. Four small agricultural road crossings are also present. These crossings are largely single-lane dirt track bridges. These roads do not appear to be influencing stream hydrology. Where Highway 48 nears the stream, some runoff may enter the channel, but evidence of significant road run-off is absent. Proposed remedial activities do not involve roadwork or the construction of permanent new roads; therefore, there should be no impacts from roads on bull trout or bull trout habitat. Limited construction road crossings consisting of temporary culverts would be installed. Culvert design has taken bull trout passage into account and as long as culverts are installed as designed, there should be little effect on bull trout movements. Temporary stream plugs composed of non-earthen material will first be placed to divert flows from the existing channel into the remediated historic channel. Subsequently these temporary stream plugs would be removed and replaced with permanent plugs composed of clean, native fill material. Stream plugs would impact the flow path as it forces water along an alternate course, but significant alterations in the magnitude or timing of stream flows are not expected.

PCE 8 - Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

The quantity of permanent water will be considered in the analyses for PCE 7 – natural hydrograph and PCE 1 – springs, seeps, and groundwater, which include *floodplain connectivity*, *changes in peak/base flows*, *drainage network increase*, *disturbance history,* and *disturbance regime*. Analysis of *temperature, sediment, and chemical contamination and nutrients* consider the quality of permanent water. Water quality analysis pertinent to *sediment* should address turbidity. Current listing under Clean Water Act (CWA) Section 303(d) and CWA 305(b) status should be considered, as well as the causes for that listing (USFWS 2013a).

As noted in the previous paragraph, PCE 8 is largely covered in the analyses conducted for other PCEs. Discussions on indicators of water quantity in relation to proposed remedial actions and bull trout can be found in the following sections:

Floodplain connectivity – PCE 1

Change in peak/base flows – PCE 7

Drainage network increase – PCE 7

Disturbance history – PCE 7

Disturbance regime – PCE 7

Discussions on indicators of water quality in relation to proposed remedial actions and bull trout can be found in the following sections:

Temperature – PCE 5

Sediment – PCE 6

Chemical contamination and nutrients – PCE 2

Warm Springs Creek from Meyers Dam to its mouth at the Clark Fork River is listed as impaired in the Montana DEQ Draft 2014 Integrated Report and 303(d) List. The listing results from not meeting its designated uses due to alteration in stream-side or littoral vegetation covers, elevated heavy metals (i.e., Arsenic, Cadmium, Copper, Iron, Lead, and Zinc), low flow alterations, and physical substrate habitat alterations. Potential sources of impairment include grazing in riparian or shoreline zones, irrigated crop production, and mill tailings. A Total Maximum Daily Load (TMDL) has also been established for Warm Springs Creek from Meyers Dam to its mouth at the Clark Fork River for sediment, metals, and temperature.

The proposed remedial actions are being considered to improve water quality so that Warm Springs Creek meets water quality standards. Contaminant removal activities would reduce the baseline level of heavy metals within the stream and would lessen the likelihood that concentration levels would spike during high flows. And, while not a primary goal of proposed remedial actions, water temperatures are likely to decrease as a result of riparian, streambank, and channel improvements. Therefore, the proposed remedial activities are likely to have a long-term positive effect on local bull trout populations. Short-term impacts from construction activities are not expected to be of a magnitude that would inhibit bull trout growth and survival.

PCE 9 - Few or no nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); inbreeding (e.g., brook trout); or competitive (e.g., brown trout) species present.

This PCE is not well covered by the existing MPI analyses. Some information may be available from the analyses of population indicators, particularly the persistence and genetic integrity indicator. Additional information was obtained from fish sampling results within the Warm Springs Creek watershed (USFWS 2013a).

Few nonnative predatory species currently exist within the Warm Springs Creek project areas and the proposed remedial actions will likely have no significant effect on whether nonnative species become established. Remedial actions are expected to improve overall stream condition and benefit the species currently inhabiting the lower reaches of Warm Springs Creek and the Upper Clark Fork River. In addition to improving conditions for bull trout, the proposed remedial actions will likely serve to improve habitat for bull trout competitors like brown trout and hybridizers such as brook trout. Both of these species are more tolerant and can occupy a broader range of habitat conditions. The only way to minimize the impact of brown and brook trout on bull trout within the project areas is to actively reduce or eliminate brown and brook trout populations. Due to the popularity of brown and brook trout fisheries, no brown or brook trout removal programs are currently planned. Therefore, bull trout within the project areas are likely to benefit from improved habitat conditions, but would face high levels of competition and hybridization from robust populations of other trout species.

Section 5

Effects of Action

Implementation of the Proposed Action would be expected to have an overall, long-term beneficial effect on bull trout and aquatic habitats. The Proposed Action would provide improved water quality with the removal of contamination, enhanced habitat in Section 32 by consolidating flow back into the main channel, and improved habitat in Lower Warm Springs Creek by restoring old channels and removing debris. These benefits would be realized along the entire stretch of Warm Springs Creek from the western extent of Section 32 to the eastern extent of Lower Warm Springs Creek (**Figures 2-2, 2-7, and 2-12**).

Due to a lack of confirmed sightings within 15 miles of the project areas and an absence of preferred habitat, proposed remedial actions are not expected to affect golden eagles. Breeding and non-breeding bald eagle activity is primarily concentrated along the Clark Fork River (USFWS 2012a). USFWS, Montana FWP, and Montana NHP do not record any bald eagle nests within 0.5 miles of the project areas. Field investigations also did not record the presence of bald eagle nests. While bald eagles may forage in the areas of Warm Springs Creek where fish are present, the project areas are not known as primary foraging sites. Eagles would likely avoid project areas during construction and would forage in nearby stream systems (e.g., Clark Fork River). Proposed remedial actions would have long-term benefits on eagle populations by improving water quality, improving fish habitat, and protecting potential nesting and perching sites in large trees within the riparian corridor. Care should be taken to avoid harming or harassing eagles during construction. If a bald eagle nest is encountered during construction, activities should comply with seasonal restrictions and construction distance buffers specified in the *2010 Montana Bald Eagle Management Guidelines: An Addendum to Montana Bald Eagle Management Plan*.

Likewise, black-crowned night heron and long-billed curlew or their nests were not observed during field investigations. These species, and other migratory birds that could potentially be found within project area habitats, would likely be temporarily displaced during construction activities. However, similar riparian habitats are located nearby and should support migratory birds until construction has been completed. Long-term benefits to migratory birds would offset temporary short-term displacement. Benefits include improved water quality, improved bank condition, improved fish and insect habitat, and protection of nesting habitat within the riparian corridor. Care should be taken to avoid harming or harassing migratory birds and their nests during construction. Any existing vegetation containing a bird nest should be avoided.

Because they share similar habitat and forage requirements, the effects of the proposed remedial actions on westslope cutthroat trout should be similar to those described for bull trout and bull trout critical habitat. These effects are described in detail in the following sections.

5.1 Short-Term Direct and Indirect Adverse Effects

The duration of the Warm Springs Creek RA activities are estimated to last approximately 2 years. Potential short-term adverse effects to bull trout and bull trout critical habitat that could result from the RA activities within the project areas of Section 32 and Lower Warm Springs Creek include increased sediment loading, entrapment associated with flow diversions, and loss of in-stream cover due to large woody debris removal. Potential direct and indirect adverse effects as a result of the proposed project are included in the following sections.

5.1.1 Temporary Increased Sedimentation

Increase sediment loading to Warm Springs Creek is expected as the result of RAs in the project areas of Section 32 and Lower Warm Springs Creek. Activities that may contribute to short-term sediment loading include:

- the installation of temporary haul roads and temporary stream crossings;
- excavation and removal of visible tailings;
- excavation and removal of existing berms;
- installation of stream plugs;
- installation of flood control berms;
- reconstruction of some of the channel of Warm Springs Creek;
- debris removal;
- selective vegetation removal;
- bank stabilization; and

An increase in sediment inputs often results in increased turbidity and sediment deposition within the stream system. The decrease in water quality and the smothering of suitable substrate would likely have an adverse impact on bull trout. However, sediment increases are expected to be small, localized, and temporary. The expected impact of sediment increases on bull trout and bull trout habitat is discussed in detail in Section 4.2 – PCE 5.

Until permanent vegetation is established in the channel reconstruction, contaminant removal, and bank stabilization areas, exposed soils and sediments would be more prone to erosion and transport into the creek, potentially impacting bull trout habitat. Although there is potential for a short-term increase in stream sediment due to the increased floodplain erosion potential, the low metals concentration in the remaining sediment will prevent a negative impact on surface water quality.

As discussed in Section 4.2 – PCE 1, construction activities, especially those associated with re-establishing historic stream flows, contaminant removal, and streambank stabilization could result in temporary pulses of sediment within the water column. It is expected that these sediment increases would be flushed quickly downstream; therefore, impacts to water quality would be small and temporary. These initial short-term impacts are expected to be offset by long-term improvements in streambank condition and floodplain connectivity which are expected to improve water quality and riparian condition, and would provide off-channel habitat favoring recruitment of prey species for bull trout.

Construction disturbance to remove the existing berm and impacted soils will be limited to small areas. The berm materials were brought on site and are considered "clean"; therefore, they will be reused for bank stabilization or as backfill in removal areas. Although there would be short-term disturbances including removal of existing vegetation and resulting temporary sediment inputs during construction, vegetation is expected to establish itself quickly due to increased moisture and opportunity for natural recruitment of native vegetation. This establishment of vegetation would be a beneficial impact to bull trout, as described in Section 4.2 – PCEs 3 and 5.

The reactivation of the historic channel at the Gochanour's property within the Lower Warm Springs Creek Project Area would relocate flows into a more geomorphically stable configuration and more established riparian corridor. However, the reactivation would likely incur some short-term adverse impacts to bull trout and bull trout habitat during construction. The reconstruction of the historic channel would remove most of the existing vegetation from streambanks. While banks would be reinforced and planted with new vegetation, initially, water temperatures could increase due to a lack of stream shading. Sediment inputs would also likely increase until newly planted vegetation became established.

Stream crossings have the potential to impede fish passage and increase sediment inputs, particularly when installed improperly. The Section 32 and Lower Warm Springs Creek project areas require temporary stream crossings to excavate and haul metals impacted soil and replacement backfill within the Warm Springs Creek corridor. A single crossing is expected to be needed to remove/replace impacted material from the "island" located in the Section 32 project area. The Lower Warm Springs Creek project area includes both broad and isolated removal areas across approximately 2.5 miles of the corridor. It is expected that 3 to 5 crossings would be needed for this work. Construction is planned to commence in late 2014 and is expected to be completed in late 2015. All temporary crossings would be removed during winter shutdown (i.e., December- April) and spring runoff periods. As a result, crossings are expected to be necessary during approximately half the year (i.e., July-November). Individual crossings would be removed once remedial activities have been completed within a given reach and the crossing is no longer required (TREC 2014).

Temporary stream crossing alternatives are being discussed with USFWS and a memorandum has been prepared by TREC entitled "Temporary stream crossings, Warm Springs Creek" (TREC 2014). Per discussions at the January 21, 2014, project coordination meeting, it was determined that this memorandum would outline various temporary stream crossing alternatives considered for the Warm Springs Creek remediation project. In addition, and as requested by the USFWS, documentation also was provided to address fish passage for the proposed design.

The closed bottom arch (squash) corrugated metal pipe design is proposed for the project. The expanded base width, coupled with flow baffles, results in reduced flow velocities to accommodate fish passage across the range of design flow rates expected to occur during the time period in which culverts would be in place (July – November). Detailed calculations and design information are provided in the Calculation Brief included as an attachment to the TREC memo (TREC 2014).

The design and seasonal nature of the temporary crossings will minimize the potential for culverts to adversely affect fish movements. The design included a fish passage analysis in which HEC-RAS and FishXing modeling were used to ensure adult bull trout adequate passage through proposed culverts (TREC 2014). While the removal of culverts from December to April will allow for unimpeded winter and spring movements, bull trout are fall migrants; therefore, these removals would be more beneficial in the fall.

While increased sedimentation associated with proposed remedial actions is expected to be small and temporary in nature, bull trout and bull trout critical habitat may be adversely affected on a localized scale. The implementation of BMPs outlined in the SWPPP and in the RAWP will likely prevent significant sediment inputs and will minimize overall effects on bull trout and bull trout habitats. BMPs to be considered are discussed in Section 5.5 below.

5.1.2 Potential Entrapment

During the construction activities associated with the reactivation of the main historical channel in Section 32, flows would be temporarily diverted into a lined secondary channel by installing a "plug" in the main channel. The temporary bypass channel will be designed to accommodate flows during low flow periods and allow for fish passage. Once the construction activities in the channel are completed, the "plug" would be removed in such a manner to minimize disturbance and limit sediment loading and increased turbidity in the stream to the maximum extent possible. For both Section 32 and Lower Warm Springs Creek water diversion activities, the initial temporary "plugs" consisting of non-earthen materials would eventually be replaced with permanent plugs composed of clean, native fill material.

During the initial installation of plugs and the diversion of flows, the movements of individual bull trout could be impeded; however, individuals would likely turn around or access alternative routes (i.e., secondary channels) when confronted with such a physical barrier. A greater threat to bull trout is when permanent plugs are installed. Permanent plugs would cut off braided channels in Section 32 and the existing channel in Lower Warm Springs Creek. The potential exists for individual bull trout to become trapped in these impounded channels, particularly the existing channel in Lower Warms Springs Creek as it is not expected to dry out. The impact of entrapment could be lessened with the establishment of a USFWS-approved catch and transport plan for these areas.

5.1.3 Removal of Large Woody Debris (LWD)

As discussed in Section 4.2 – PCE 4, LWD is naturally limited within the Section 32 Project Area due to narrow forested riparian corridors. LWD is even less prevalent in Lower Warm Springs Creek because riparian areas within that project area are dominated by smaller willows. However, LWD has accumulated in several locations due to natural choke points and beaver activity, and has contributed to the diversion of flow out of the main channels and into side channels. LWD and its ability to create large debris dams is a primary cause of the braided channel system in Section 32.

One of the goals of the proposed remedial actions is to remove debris from stream channels and to limit future LWD for channel stability and flood control purposes. In areas with large boulders, undercut banks, or other sufficient cover, the impact of less LWD would be minimal. However, in many areas, LWD provides the only cover and its removal and future absence may render these stream reaches unsuitable for bull trout. The expected impact of less LWD on bull trout and bull trout habitat is discussed in detail in Section 4.2 – PCE 4.

5.2 Short-term Direct and Indirect Beneficial Effects

5.2.1 Grazing and Land-use Restrictions

Section 4.2 – PCE 5 notes that grazing and other land use restrictions associated with proposed remedial actions would protect riparian, floodplain, and streambank areas from degradation. These restrictions are related to the proposed BMPs, discussed in detail later in Section 5.7. These restrictions would limit access to remediated floodplain areas and streambanks and would be consistent with the Final Institutional Control Management Plan (ICMP). These restrictions would be beneficial to bull trout and bull trout critical habitat in the short-term and long-term by reducing nutrient and pathogen inputs, preventing bank trampling, and protecting riparian vegetation.

5.2.2 Removal of Existing Berm and Impacted Soils in Section 32

The "island" will now be accessible to out of bank flows allowing for inundation during events exceeding the capacity of the north and south channels. Benefits to vegetation will be almost immediate due to the increase in moisture and natural recruitment opportunities. Additional benefits to bull trout and bull trout critical habitat associated with this improvement in floodplain connectivity are discussed in Section 4.2 – PCE 1.

5.3 Long-Term Direct and Indirect Adverse Effects

5.3.1 Loss of Undercut Bank Habitat

As discussed in Section 4.2 – PCE 4, in comparison to Section 32, Lower Warm Springs Creek contains large stretches of undercut banks created by scouring beneath dense root masses. Remedial actions and bank reconstruction would remove a significant portion of existing undercut banks, thereby degrading preferred bull trout habitat. Undercut banks are unlikely to reform in the short-term because bank reconstruction and stabilization measures call for shallower, vegetated slopes resistant to bank scour. Despite the loss of undercut bank habitat, long-term bank stability and shallower bank slopes would benefit bull trout and bull trout critical habitat by improving water quality, creating productive shallow-water habitats, and replacing undercut bank habitat with in-channel structure provided by willow plantings.

5.3.2 Loss of Wetland Habitat

The removal of debris dams and beavers from the Section 32 project area is likely to reduce off-channel stream and wetland habitat. The freshwater marsh supported by the braided channel system and beaver activity would likely transition to a drier plant community once water is diverted. In addition, to the east of the braided section, the north channel (**Figure 2-3**), which now conveys 50 percent of stream flows, would likely revert back to an ephemeral system. These smaller channels and freshwater marsh systems do not consist of preferred bull trout habitat; therefore, bull trout are unlikely to be directly affected. However, the loss of off-channel stream and wetland habitats may decrease recruitment of preferred prey species that thrive in these conditions. Additional information on this potential adverse effect is included in Section 4.2 – PCE 2.

5.3.3 Potential Entrapment – Lateral Berms

Figures 2-5 and 2-6 depict the plans for Section 32. As can be seen from the figures, four lateral berms are to be constructed to help control flooding to the north and northeast of the project area. During flood events, bull trout may access floodplain areas between the berms in search of food. As floodwaters recede, there is a possibility that bull trout could be trapped and stranded, and unable to return to the main channel of Warm Springs Creek. While the probability of frequent and/or significant bull trout entrapment is remote, fish are routinely stranded in side channels and fields within the Warm Springs Creek watershed following flood events.

5.4 Long-term Direct and Indirect Beneficial Effects

5.4.1 Creation of Off-channel Backwater Habitat

For Lower Warm Springs Creek, the reactivation of the historic channel at the Gochanour's property will relocate the flows into a more geomorphically stable configuration and more established riparian corridor compared to the existing condition. The existing channel would be abandoned and "plugs" would be installed to create off-channel wetland areas. A detailed discussion on the potential effects of this action on bull trout and bull trout critical habitat is included in Section 4.2 – PCEs 3 and 4.

5.4.2 Water Quality Improvements – Contaminant Removal

As documented in text from Section 4 concerning PCE 2 and PCE 8, historical contamination due to smelting operations has degraded water quality and sediment quality with elevated levels of heavy metals, particularly copper, are observed during high flows. Within Section 32, significant quantities of contaminated sediment have already been removed from the floodplain. When compared with Section 32, Lower Warm Springs Creek still possesses significant quantities of contaminated sediment within the floodplain, which makes its way into the stream through erosion and flood events. The proposed remedial actions are being considered to improve water quality so that Warm Springs Creek meets water quality standards and results in better habitat for bull trout. Contaminant removal activities would reduce the baseline level of heavy metals within the stream and would lessen the likelihood that concentration levels would spike during high flows, and have adverse impacts upon bull trout via ingestion and bioaccumulation in prey items.

Barren areas (slickens) currently do not support vegetation. Once these areas are remediated, vegetation is expected to establish itself and reduce the potential for erosion. Again, if some soils erode during the interim, the sediments are considered "clean" and should not adversely affect surface water quality. The grading, stabilization, and planting of eroded and denuded streambanks would limit erosion and would contribute to future thermal cover to the stream; thereby improving bull trout habitat.

5.4.3 Improved Floodplain Connections

Improved connection is likely to increase recruitment of prey species by providing foraging and spawning/rearing habitat. As noted in Section 4.2 - PCE 1, PCE 3, and PCE 4, long-term improvements in streambank condition and floodplain connectivity are expected to improve water quality, riparian condition, and would provide off-channel habitat favoring recruitment of prey species. Diverting flows back into the historic channel would transform the existing channel into an off-channel pond or wetland habitat. This off-channel habitat would be connected to the main channel during flood events and could provide expanded foraging opportunities for bull trout when accessible.

The re-developed historic stream channel in Section 32 has been designed to convey the 2-year storm event. During larger events, flows will spread onto the floodplain and access existing secondary channels. A large number of these areas are already established and will not be disturbed during the construction activities. Floodplain access and side channel activation at larger flow events will provide refugia for fish, promote insect recruitment, support floodplain vegetation, and reduce shear stress and erosion potential on the banks and bed of the primary channel.

5.4.4 Increased Flows and Water Depths

Bull trout require habitats with sufficient flow and depth for movement, cover, and thermal refuge. The north and south channels are both currently active at normal flow conditions. The split flow condition, in conjunction with floodplain sheetflow, likely contributes to thermal loading in the reach. Flow re-concentration into a single thread would reduce the potential for thermal gains in the reach.

For Section 32, the re-routing of flows away from the braided system and back into the main channel would likely benefit large, mature trees within the riparian area, which would keep the main stream channel well shaded. The re-establishment of historical flow patterns to the main channel may also promote the growth of large tree species in relation to the inundated, freshwater marsh and braided channel system that favors smaller shrubs and herbaceous plants. Increased water depths associated with concentrating flow back into the main channel would enable fish, including bull trout, to traverse shallow stream sections. It would also increase pool depths and lessen the likelihood that ice dams form or that the stream will freeze solid. The resulting deep-water habitats would also serve as thermal refugia for bull trout, and will contribute to an overall increase in water quantity with the main channel thereby establishing higher and more consistent base flow conditions.

5.4.5 Construction Channel Scours – Increased Habitat Heterogeneity and Pool Variability

In areas where within-channel remediation is planned, especially in Lower Warm Springs Creek, uneven scouring of the channel will be required of the construction contractor. This scouring would result in an increase in habitat heterogeneity and pool variability, and would contribute to improved habitat for bull trout.

5.4.6 Streambank Stabilization

These shallower, vegetated slopes would augment existing vegetation, reduce erosion rates and sediment inputs, and would improve riparian habitat. Bull trout should see indirect benefits from these actions including increased water quality, stream shading, and prey recruitment.

5.4.7 Grazing Restrictions

Grazing restrictions would protect riparian, floodplain, and streambank areas resulting from impacts of livestock. These restrictions are related to the proposed BMPs, discussed in detail later in Section 5.7. These restrictions would be consistent with the ICMP and would be beneficial to bull trout and bull trout critical habitat in the short-term and long-term by reducing nutrient and pathogen inputs, preventing bank trampling, and protecting riparian vegetation.

5.4.8 Debris and Beaver Dam Removal

As noted in Section 4.2 - PCE 2, one of the primary goals of the remedial actions is to remove debris dams and reduce the impact of beaver activity for flood control purposes. Debris and beaver dam removal would prevent water from backing up and would promote the flushing of debris and fine sediment through the system. Removal of these dams should provide bull trout with access to portions of the stream that were once cut-off.

5.5 Cumulative Effects

Under the ESA, cumulative effects are defined as the effects of future State or private activities not involving Federal activities that are reasonably certain to occur within the action area of an action subject to consultation. Cumulative effects are defined differently for purposes of the National Environmental Policy Act (NEPA). The focus of the Section 32 and the Lower Warm Springs Creek projects is to remove certain identified contamination and reduce area flooding. Since the area is also within Bull Trout Designated Critical Habitat, the goal is also to protect bull trout and bull trout habitat to the extent possible. No significant development projects or land use changes are expected within the Section 32 and Lower Warm Springs Creek project areas for the 2-year duration planned for remediation.

Potential cumulative impacts resulting from the Proposed Actions for Section 32 and Lower Warm Springs Creek are provided in the sections below.

5.5.1 Increased Angling Pressure

Angling pressure may increase as the trout habitat improves and more trout use the areas. The angling pressure would be focused on brown and brook trout, but on rare occasions bull trout may be taken. Increased angling pressure is a potentially adverse cumulative impact.

5.5.2 Potential Increase in Brown and Brook Trout

As trout habitat improves, higher numbers of brown and brook trout would be expected. Increased numbers of brown and brook trout could result in increased competition for habitat and prey for the bull trout. An increase in other trout species could also increase the potential for hybridization. Increased competition and increased hybridization are potentially adverse cumulative impacts for bull trout.

5.5.3 Increase in Habitat Quality for Bull Trout

With the remediation and the proposed alterations in Section 32 and Lower Warm Springs Creek, a net long-term benefit for bull trout and their habitats is expected. Long-term benefits would come largely from channel stability, contaminated sediment removal, decreased width-to-depth ratios, bank stability, improved water quality, and improved and protected riparian buffers.

5.5.4 Improved Connectivity between Suitable Bull Trout Habitats

Currently, bull trout in the Upper Clark Fork River Basin have a fragmented distribution, with populations separated by stretches of unsuitable habitat. The proposed remediation and channel alterations for the Section 32 and Warm Springs Creek projects would result in better connectivity between suitable habitats. This connectivity would improve along Warms Springs Creek in the both the Section 32 and the Lower Warm Springs Creek areas.

5.6 Conservation Measures and Short-term Best Management Practices (BMPs) Related to the Protection of Bull Trout and Bull Trout Critical Habitat

5.6.1 Conservation Measures

The Upper Clark Fork River Critical Habitat Subunit (CHSU) is essential to bull trout conservation because it is the uppermost extension of the migratory habitat for bull trout originating in Lake Pend Oreille or downstream portions of the Clark Fork River. Bull trout population levels are depressed and the habitat is fragmented due mostly to impacts from past land and water use activities. As a result, recovery potential may be limited, but some strongholds remain (e.g., Flint Creek and Warm Springs Creek headwaters), and it's important to secure these strongholds to sustain the genetic attributes those populations may represent. Long-term protection of water quality and quantity, especially satisfactory thermal conditions, are amongst the most important elements of the recovery strategy in the Upper Clark Fork River corridor. Recovery is especially relevant given that high summer water temperatures, largely unsuitable for bull trout, are frequently recorded in this CHSU. The Upper Clark Fork River CHSU includes the Clark Fork River headwaters in western Montana upstream from the confluence of the Blackfoot River, with the exception of the Blackfoot River, Clearwater River, and Rock Creek drainages, which are separate CHSUs. Of the waters located within the Upper Clark Fork River CHSU, 441.9 km (274.6 mi) of stream are designated as critical habitat for bull trout in Missoula, Granite, Powell, and Deer Lodge Counties (USFWS 2010). The following water bodies are included in this CHSU:

> (A) The Clark Fork River from the confluence of the Blackfoot River upstream approximately 207.3 km (128.8 mi) to its confluence with Warm Springs Creek provides foraging, migration, and overwintering (FMO) habitat for migratory bull trout.
>
> (B) Harvey Creek from its confluence with the Clark Fork River upstream 24.9 km (15.5 mi) to its headwaters provides spawning and rearing habitat.
>
> (C) Flint Creek is occupied by bull trout at low abundance. From its confluence with the Clark Fork River upstream 68.0 km (42.3 mi) to its confluence with Boulder Creek, Flint Creek provides FMO habitat, with spawning and rearing habitat in the upper reaches to its source at Georgetown Lake. Boulder Creek from its confluence with Flint Creek upstream 22.5 km (14.0 mi), and South Boulder Creek from its confluence with Flint Creek upstream 13.7 km (8.5 mi) to their headwaters, provide spawning and rearing habitat.

The lower 17.0 km (10.6 mi) of Warm Springs Creek functions as FMO habitat. The remaining upper 32.6 km (20.2 mi) of Warm Springs Creek to its headwaters provides occupied migratory and spawning and rearing habitat supporting primarily resident bull trout. Spawning and rearing habitat in the upper tributaries of Warm Springs Creek includes the following: Barker Creek from its confluence with Warm Springs Creek upstream 8.0 km (5.0 mi) to its headwaters at Barker Lake; Foster Creek from its confluence with Warm Springs Creek upstream 15.8 km (9.8 mi) to its headwaters; Twin Lakes Creek from its confluence with Warm Springs Creek upstream 14.5 km (9.0 mi) to its headwaters; and the entire 17.6 km (10.9 mi) of Storm Lake Creek (USFWS 2010).

The USFWS Bull Trout 5 Year Review documents how the implementation and effectiveness of regulatory mechanisms vary across the coterminous range. Some State Forest practices and their rules have been updated for the protection of threatened, endangered, and sensitive species (USFWS 2008). USFWS listed brief summaries of all State forest practices and rules that benefit bull trout when implemented and noted that Montana Streamside Management Zone Act regulations, implemented in 1993, mandates a 50-100 foot zone around streams, lakes, and wetlands where timber harvest, broadcast burning, equipment operation, road construction, slash deposition, and toxic material handling are regulated. More specific provisions are included in the Montana Guide to Streamside Management Zone Law and Rules (MDNRC 2006).

Stable bull trout populations require conservation approaches and management plans that focus on high-quality habitat. Not only must all habitat requirements be available for bull trout to persist in a system, the population must be sufficiently large, or must be composed of enough subpopulations, to maintain genetic variability and survive catastrophic events, normal environmental variation, and the effects of human activities (Rieman and McIntyre 1993).

As a first step to maintaining bull trout populations, management should identify and protect those habitats in the best condition with the strongest populations. The second step should be to develop a system of conservation areas that are managed to maintain or restore the ecological processes necessary for the long-term presence of bull trout (Rieman and McIntyre 1993). Maintaining or restoring these core conservation areas would include activities to improve riparian habitat, bank/channel stability, and water quality. Improving habitat quality may have to be supplemented with the removal of non-native competitors including brook trout and bull trout; however, this may not be needed. In studies correlating the absence of bull trout with the presence of brook trout in western Montana, bull trout appear to have increased resistance to invasion by brook trout in streams with high habitat complexity and connectivity (Rich Jr et al. 2003).

5.6.2 Short-term BMPs Related to the Protection of Bull Trout and Bull Trout Critical Habitat

In order to limit and minimize sediment loading the following conservation measures and BMPs should be implemented (CDM Smith 2014):

1. Avoid and minimize impacts to streambanks during removal and in-situ activities and during planting to prevent bank destabilization. A minimum 5-foot wide native buffer is to be maintained along the streambanks. Maintenance of the "buffer strip" will provide protection against runoff from the excavation area toward the stream and also provide channel stability and protection of the excavation areas should unexpected high flow conditions associated with short-term storm events occur within Warm Springs Creek. The native buffer will become a temporary high point between the excavated floodplain and the receiving water and will therefore serve to prevent uncontrolled runoff from entering the stream. Portions of the 5-foot native buffer will be removed during the construction of stream bank stabilization measures. Removal of the native buffer is to be performed in small portions and immediately followed by the installation of streambank treatments. Removal of soils within the 5-foot buffer is to be completed using equipment that prevents side casting of materials into Warm Springs Creek, such as an excavator (Atlantic Richfield 2013).

2. Minimize re-contamination of the site by starting construction in Section 32 and working downstream.

3. Toe material harvested on site will be of similar size and shape as rock typically found in the streambanks and bed material. This allows for current aquatic and benthic habitats to be reestablished faster.

4. Native desirable woody vegetation will not be disturbed during construction activities to the maximum extent possible. Haul roads and staging areas will be limited in extent and located so as to minimize disturbance of existing vegetation. Staging areas will be located outside of riparian areas.

5. Construction activities will be performed in a manner to minimize discharges into Warm Springs Creek to the maximum extent practicable. In addition to those conditions outlined in construction stormwater permits, Best Management Practices (BMPs) will be employed to manage stormwater runoff and reduce water quality degradation during and after construction. All remediated lands will be protected to allow for adequate establishment and growth of new vegetation. Land owner agreements will be secured to ensure proper land management.

6. Bank treatments will be designed to be deformable at and above the selected design discharge for bank deformability. Below the design discharge, bank toes and upper banks will be designed for non-deformability.

7. Unnecessary removal of toe material will potentially destabilize banks and result in sediment loading downstream. Care will be taken to remove only contaminated toe material, and to minimize sediment loading in the creek to the maximum extent possible. When possible, reconstructed streambanks will be installed in dry conditions through strategic project staging, flow diversions, and flow deflection.

8. Vegetation will be planted in contact with the low water table or the capillary fringe at base flow to encourage survival, rapid growth, and effective bank reinforcement.

9. Construction activities will be scheduled to minimize impacts to aquatic life and wildlife.

10. Streambanks that failed or were damaged during a large runoff event will be repaired or replaced as soon as possible.

11. Fencing will be installed to limit cattle grazing

12. Turbidity Controls: In order to achieve project objectives, some work must be performed within the immediate proximity to the stream channel under flowing conditions with the potential to release sediments into the active watercourse. The following construction BMPs will be implemented for work along Warm Springs Creek or its tributary channels to reduce sediment loading and excessive turbidity:

- A vegetative buffer strip of native soil/vegetation may be left along the channel at select locations during the major floodplain stripping activities;
- Removal of tailings/impacted soils from streambanks will be completed using excavators (or similar equipment) to prevent side-casting of materials into Warm Springs Creek, and equipment will generally be required to track perpendicularly to the streambanks to prevent bank collapse or equipment falling into the stream;
- Excavation within streambanks will be followed as soon as possible by the installation of streambank treatments to minimize the period of instability;
- All streambank work will be done during periods of low flow;

- Clear water diversions, cofferdams, and/or pumping may be necessary to isolate or dewater some streambank treatment sites depending on the extent of contaminants or erosion encountered;
    - No dewatering effluent will be discharged into Warm Springs Creek until visually free of sediments; and
    - Temporary channel crossings will be constructed for equipment access and no heavy equipment shall be allowed to enter the active stream channel.

13. Stormwater Management: Temporary construction BMPs for stormwater management are described in detail in the Storm Water Pollution Prevention Plan (SWPPP) provided as Appendix D of the RAWP (Atlantic Richfield 2013). The purpose of the SWPPP is to ensure that the substantive requirements of the Montana General Permit for Storm Water Discharges Associated with Construction Activity are met during the RA construction activities. During site work activities, standard BMPs shall be followed/installed, as appropriate, to divert stormwater around the work area, minimize off-site sediment tracking, and to prevent stormwater runoff from transporting sediments and/or pollutants (e.g., construction related oils, fuels, and other materials) down-gradient into Warm Springs Creek or adjacent wetlands. These measures may include, but are not limited to, vegetative buffer strips, stabilized construction entrances, silt fence, straw wattles, rock outlets, wetland barriers, and good housekeeping practices (Atlantic Richfield 2013).

14. Institutional Controls: The Final ICMP in conjunction with the selected reclamation and engineering controls will include three basic components: land use restrictions and zoning, groundwater controls, and public notices or advisories (Atlantic Richfield 2013).

15. Grazing Management: Grazing restrictions are planned for the near stream corridor throughout the entire length of Lower Warm Springs Creek (pending Landowner Agreement coordination). Per Section 4.2 of the RAWP, structural barriers (i.e., wire fence) are planned to be constructed around remediated floodplain areas and streambanks for the purpose of prohibiting livestock access and preventing negative land use impacts to the remedy. Fencing would remain in place until performance standards for all components of the remedy have been attained (typically a period of 5 years for revegetation). Access to Warm Springs Creek for the purpose of livestock watering during periods of remedy establishment may be provided by means of fenced and stabilized stream access points (water gaps) to be constructed as a component of the RA. Similar grazing restrictions may be employed for the portion of the project area currently owned by Atlantic Richfield if grazing within that parcel is to be permitted or is anticipated. Limiting grazing within the riparian corridor during the interim establishment period will allow the system to recover if hydric soils have not been lost due to extensive soil compaction and if there are existing populations of herbaceous native species (sedge, rush and native grasses) that possess rhizomatous root systems capable of recolonizing on disturbed soils (TREC 2013a).

16. Monitoring Plans: Monitoring would commence immediately following construction completion and is expected to be ongoing for anywhere between 5-10 years depending on the system's response. Monitoring emphasis is placed on assessing bank stability (i.e., assess bank toes and fabric, short-term/long-term willow density, canopy cover, etc.) and evaluating establishment of vegetative cover (i.e., vegetation canopy cover, woody density, etc). Additional monitoring specific to bull trout or bull trout habitat conditions (i.e., water temperature, pool variability, in-stream structure) are not planned at this time.

17. Restricted Land Use: During and after construction, landowners will be required to manage the remediated areas as required in the ICMP and the owner's agreement with ARCO. Access to the banks will be limited until vegetation is established.

18. Work in the historic channel and existing channel will be conducted in dry conditions. This reduces sediment loading and expedites construction activities, which consequently reduces the time stream flows need to be diverted.

19. Materials removed from the channel will be reused when possible (i.e., woody debris will be placed in the floodplain to increase microtopography and create habitat). Channel bed material will be cleaned and reused in areas that require backfill.

20. Project oversight personnel will coordinate with the contractor to minimize the number of temporary stream crossings to be installed and limit the timeframes in which the crossings will remain within the channel. Oversight of the installation and removal of the temporary crossings will help to minimize the impact to riparian vegetation and stream bed material. Upon installation, flow conditions will be observed and large cobble bed material will be selectively placed to create backwater conditions to further reduce culvert outlet velocities, if necessary (TREC 2014).

21. Traffic to and from the "island" in Section 32 will be limited due to the reuse of materials and due to the fact that only one creek crossing is currently being proposed.

In addition to the conservation measures and BMPs listed above, a plan should be devised and implemented prior to construction that instructs construction personnel on courses of action should bull trout be observed or encountered. This plan should involve immediately stopping activities that could result in harm or harassment to bull trout and USFWS should be notified. In cases where the bull trout has become entrapped, a USFWS-approved catch and transport plan should be in place to safely move bull trout out of impoundments or active construction areas.

5.7 No Action Alternative

Over the years, various alternative remedial designs and actions have been considered and assessed for the Section 32 and Lower Warm Springs Creek project areas. These designs were selected or rejected largely based on feasibility, cost, and the potential to impact bull trout and bull trout critical habitat. One example that highlights the selection process, previously discussed in Section 5.1.1, is the selection of temporary stream crossing culverts. A culvert design was selected that was feasible, cost-effective, and provided adequate fish passage with the least impact to existing aquatic habitats.

Details regarding various alternative remedial designs and actions that were considered can be found throughout the RAWP (Atlantic Richfield 2013). Atlantic Richfield was only held to eliminating exposed tailings; therefore, an option was considered, and quickly dismissed, that would have removed contaminated sediments, installed riprap along eroding banks, and included little to no restoration. This option would have resulted in increased water quality but additional habitat improvements would not have been realized. Alternatives were also considered that balanced the loading risk against disturbing existing stable banks and quality riparian vegetation. It was determined that spot contaminant removal would be the best course of action in areas where stable banks and established vegetation were present; thereby avoiding direct impacts to these high-functioning areas.

Due to the nature of the project, the analysis of alternatives will be limited to the No Action Alternative. The proposed remedial actions are being implemented only because tailings located adjacent to Warm Springs Creek continue to erode and cause water quality impairments. The greatest cause for concern occurs during high flow (bankfull) discharge events when the copper chronic aquatic life water quality standards are routinely exceeded. If the No Action Alternative is selected, copper exceedences would continue into the future, adversely affecting aquatic life and aquatic habitats, including bull trout and bull trout critical habitat.

In addition to continued water quality impairments associated with metals loading, the No Action Alternative would largely result in the opposite of the effects described in Section 5.1 through Section 5.5. While some adverse effects such as temporary increased sedimentation would be avoided, the multitude of short-term and long-term beneficial effects would not be realized. This would include increased habitat heterogeneity, increased floodplain connection, improved bank condition, increased flow and water depth, and improved riparian condition. The cumulative effect of the No Action Alternative would be continued degradation of aquatic habitats due to impaired water quality and physical channel condition. Confirmed sightings of bull trout within the project areas would continue to be rare or non-existent and bull trout critical habitat indicators would continue to trend towards functioning at an unacceptable risk.

Section 6

Determination of Effects

The assessment of potential effects in *Section 4 Crosswalk Analysis* and *Section 5 Effects of Action* concluded that implementation of the proposed remedial actions would be expected to have an overall, long-term beneficial effect on bull trout and bull trout designated critical habitat. These expected benefits would be realized for the Section 32 and Lower Warm Springs Creek project areas and areas located directly adjacent and downstream. Long-term benefits are expected to extend indefinitely into the future and would directly and indirectly contribute to the recovery of bull trout subpopulations and designated critical habitat in the lower reaches of Warm Springs Creek and throughout the Upper Clark Fork River Basin.

Despite these overall expected benefits, there is a potential for short-term and long-term adverse effects on bull trout critical habitat while implementing the proposed remedial actions. Resultant short-term adverse effects would be small in magnitude, short in duration, and temporary in nature. Ecologically-sound construction methods, BMPs, and conservation measures associated with proposed remedial actions should minimize the potential for short-term effects. If they should occur, these precautions would likely minimize their magnitude and duration. Effects should be abated with the completion of construction activities or establishment of additional BMPs.

Potential long-term adverse impacts vary in their significance to bull trout and bull trout habitat. The loss of wetland habitat in Section 32 is relatively insignificant to bull trout directly, but may have indirect effects related to prey recruitment. The establishment of four perpendicular berms may trap individual bull trout as flood waters recede; however, the likelihood of entrapment is remote. Conversely, the loss of undercut bank habitat is extremely likely and would eliminate refugia for bull trout. However, the removal of undercut bank habitat is required to improve bank stability and riparian condition, which will result in improved water quality and stream shading. Overall, it is expected that any residual adverse effects would be outweighed by the long-term benefits expected to accrue for bull trout and bull trout critical habitat once remediation activities have been completed.

The Dichotomous Key for Making Endangered Species Act (ESA) Determinations of Effect (**Table 6-1**) is designed to aid in determinations of effect for proposed actions that require a Section 7 consultation/conference or permit under Section 10 of the ESA (USFWS 1998a). The Dichotomous Key is used to help make ESA determinations of effect. If it is determined that the proposed actions will result in a "take", the expected "take" is identified on the "Documentation of Expected Incidental Take" form that accompanies the Dichotomous Key.

The overall determination of effects of the proposed Warm Springs Creek remedial actions on bull trout and bull trout habitat may fall within one of three ESA effects thresholds:

No Effect – This determination is only appropriate if the proposed action will literally have no effect whatsoever on bull trout and/or bull trout critical habitat, not a small effect or an effect that is unlikely to occur. Furthermore, actions that result in a beneficial effect do not qualify as a "no effect" determination (USFWS 1998a).

May Affect, Not Likely to Adversely Affect – This determination is the appropriate conclusion when effects on bull trout or bull trout critical habitat are expected to be beneficial, discountable, or insignificant. Insignificant effects relate to the size of the impact and should never reach the scale where "take" occurs, and discountable effects are those extremely unlikely to occur (USFWS 1998a).

May Affect, Likely to Adversely Affect – This determination is the appropriate conclusion if any adverse effect to listed species or critical habitat may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions. In the event the overall effect of the proposed action is beneficial to bull trout or bull trout critical habitat, but is also likely to cause some adverse effects, then the proposed action "is likely to adversely affect" (USFWS 1998a).

Table 6-1 Dichotomous Key for making ESA Determination of Effects (USFWS 1998a)

(Circle the conclusion at which you arrive)

1. Are there any proposed/listed fish species and/or proposed/designated critical habitat in the watershed or downstream from the watershed?

   NO.. **No effect**

   YES (or unknown) .... Go to 2

2. Will the proposed action(s) have any effect whatsoever[1] on the species and/or critical habitat?

   NO.. **No effect**

   YES .... Go to 3

3. Does the proposed action(s) have the potential to hinder attainment of relevant "functioning appropriately" indicators (from table 2)?

   A. NO .... Go to 4

   B. YES... Go to 5

4. Does the proposed action(s) have the potential to result in "take"[2] of any proposed/listed fish species or destruction/adverse modification of proposed/designated critical habitat?[3]

   A. NO .... **Not likely to adversely affect**

   B. YES.. **Likely to adversely affect**

5. Does the proposed action(s) have the potential to result in "take"[2] of any proposed/listed fish species or destruction/adverse modification of proposed/designated critical habitat?[3]

   A. NO .... **Not likely to adversely affect**

   B. YES .... **Likely to adversely affect**

[1] **Any effect whatsoever** includes small effects, effects that are unlikely to occur, and beneficial effects (all of which are recognized as may affect determinations). A **no effect** determination is only appropriate if the proposed action **will literally have no effect whatsoever** on the species and/or critical habitat, **not** a small effect, an effect that is unlikely to occur, or a beneficial effect.

2 **"Take"** - The ESA (Section 3) defines take as "to harass, harm, pursue, hunt, shoot, wound, trap, capture, collect or attempt to engage in any such conduct". The USFWS further defines "harm" as "significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering", and "harass" as "actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering".

3 **Document expected incidental take** on the "Documentation of Expected Incidental Take" form in Section 6.1.

Although the intent of the proposed remedial actions is to improve degraded conditions over the long-term, some short-term impacts (i.e., temporary sedimentation) may result in incidental take of individual bull trout and would likely cause adverse effects to bull trout critical habitat. Therefore, the appropriate determination under the ESA with respect to the proposed remedial actions is "May Affect, Likely to Adversely Affect" bull trout and bull trout designated critical habitat on a short-term basis during construction.

Bull trout individuals have not been recorded as being present within the lower reaches of Warm Springs Creek during recent Montana FWP fish sampling events. While the potential take of bull trout individuals is remote, the determination that proposed remedial actions "May Affect, Likely to Adversely Affect" bull trout is for the most part based on short-term adverse impacts to designated bull trout critical habitat. Despite scant evidence of resident bull trout in Warm Springs Creek below Meyers Dam, there is the possibility that bull trout from confirmed source populations upstream of the dam and downstream in other Clark Fork River tributaries would pass through the project areas during migration or in search of suitable habitat.

The proposed remedial actions would not result in the destruction or adverse modification of bull trout critical habitat because the expected adverse impacts are largely small in magnitude and temporary in nature, and are outweighed by the magnitude of beneficial effects. Ecologically-sensitive construction methods, BMPs, and conservation measures would also greatly reduce the potential for and magnitude of adverse effects. Therefore, proposed remedial actions are not likely to jeopardize the continued existence of bull trout or bull trout critical habitat. As discussed above, the overall long-term effect of the proposed remedial actions would be to benefit and contribute to the recovery of bull trout subpopulations and bull trout critical habitat in the lower Warm Springs Creek and Upper Clark Fork River Basin.

6.1 Documentation of Expected Incidental Take

The proposed remedial actions "May Affect, Likely to Adversely Affect" bull trout and bull trout critical habitat because they may result in take of bull trout and may adversely modify bull trout critical habitat. In such cases, USFWS requires documentation of expected incidental take, which is satisfied by completing the Documentation of Expected Incidental Take form (USFWS 1998a).

DOCUMENTATION OF EXPECTED INCIDENTAL TAKE

Name and location of action(s): Remedial Design Unit 10-Warm Springs Creek; Anaconda, MT

Species: Bull Trout (*Salvelinus confluentus*)

1. *The proposed action may result in incidental take through which of the following mechanisms (circle as appropriate)?*

   Harm: Significant impairment of behavioral patterns such as breeding, feeding, sheltering, and others (identify).

   - Loss of undercut bank habitat, particularly in Lower Warm Springs Creek, where banks will be graded and stabilized to improve floodplain connection.
   - Potential entrapment of individuals located in Section 32 side channels or within the Lower Warm Springs Creek existing channel when stream flows are diverted. Effect may be lessened by USFWS-approved catch and relocation of entrapped individuals.
   - In Section 32, the establishment of four perpendicular berms may trap individuals as flood waters recede. However, likelihood is low and fish becoming stranded is a common occurrence in natural off-channel and riparian habitats following flood events.

   Harass: Significant disruption of normal behavior patterns which include, but are not limited to, breeding, feeding, sheltering, or others (identify).

   - Temporary increased sedimentation from contaminant removal, bank stabilization, berm removal, channel realignment, and other construction activities.
   - Loss of wetland habitat associated with the braided channel system in Section 32.
   - Removal of large woody debris from the channel removes underwater structure that bull trout often use for cover.

   Pursue, Hunt, Shoot, Wound, Capture, Trap, Collect: N/A

2. *What is the approximate duration of the effects of the proposed action(s) resulting in incidental take?*

   Construction activities associated with remedial actions are expected to be completed within two years.

3. *Which of the following life stages will be subject to incidental take (circle as appropriate)?*

   Fertilization to emergence (incubation)

   Juvenile rearing to adulthood

   Adult holding and overwintering

   Adults spawning

   Adults migrating

4. *Which life form and subpopulation status are present in the watershed or downstream of the watershed where the activities will take place (circle as appropriate)?*

Life Form:	Subpopulation status:
Resident	**Stronghold population**
Adfluvial	**Depressed population**
Fluvial	
Anadromous	

5. *What is the location of the expected incidental take due to the proposed action(s)?*

Basin and watershed:
Warm Springs Creek – Upper Clark Fork River Basin

Stream reach and habitat units:
Lower reaches of Warm Springs Creek from Galen Road downstream to the Johnson Ranch property line.

6. *Quantify your expected incidental take:*

Length stream affected (miles):
Approximately 2.54 miles of Warm Springs Creek is included within the project areas. In-stream work will be limited to approximately 1.25 miles (**Figure 2-2; Figure 2-7**).

Individuals (if known):
Not known. Bull trout are rarely documented within or adjacent to the project areas, and the local subpopulation is estimated to consist of less than 50 individuals.

Section 7

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Attachment A

Path: Z:\gis\Public\Anaconda_MXD\WSC_BiologicalAssmt2013\SOC_DeerLodge_Mammals.mxd

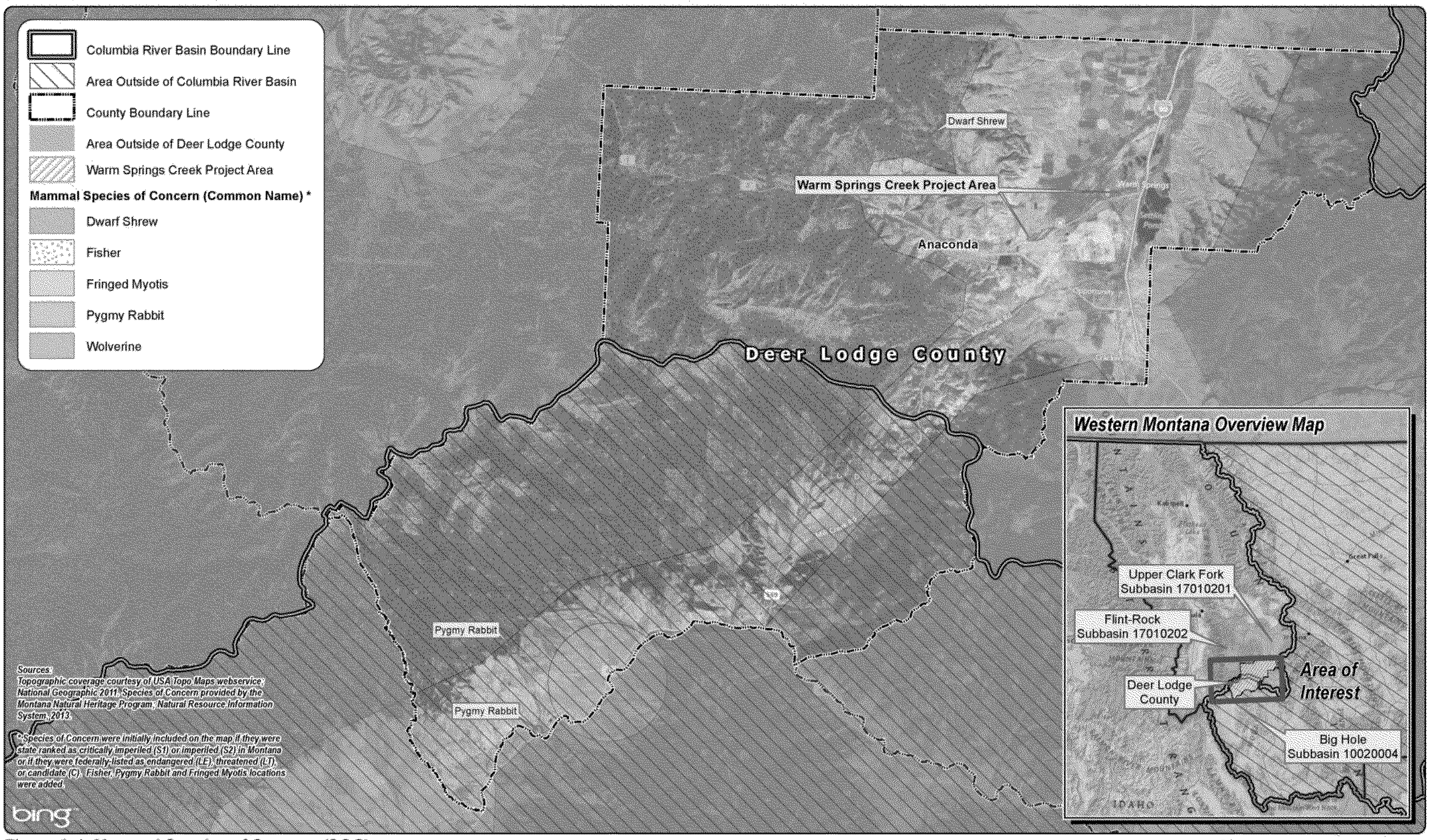

Figure A-1. Mammal Species of Concern (SOC) in Deer Lodge County, Montana

Warm Springs Creek Biological Assessment - Anaconda, MT

CDM Smith

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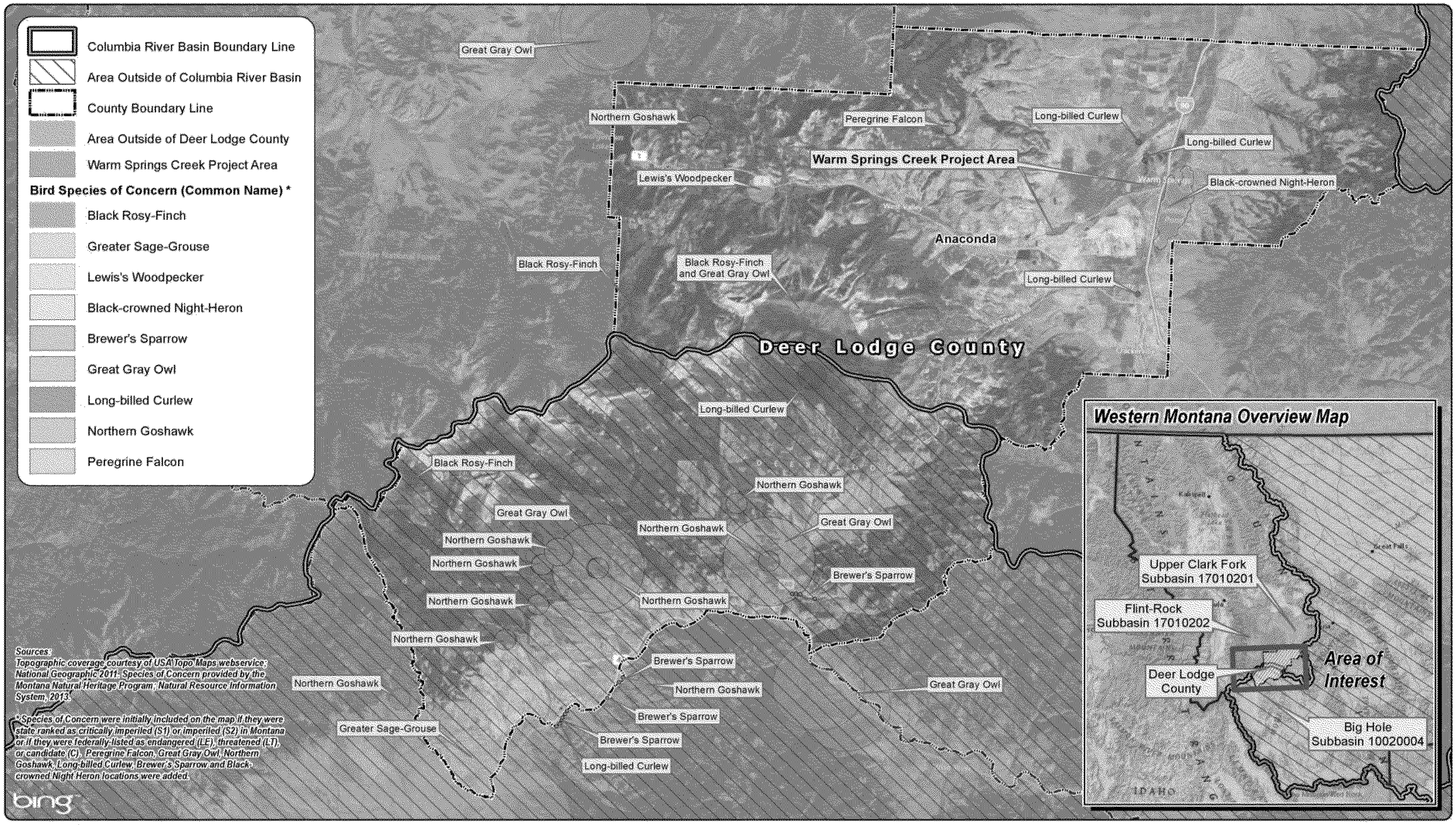

Figure A-2. Bird Species of Concern (SOC) in Deer Lodge County, Montana

Warm Springs Creek Biological Assessment - Anaconda, MT

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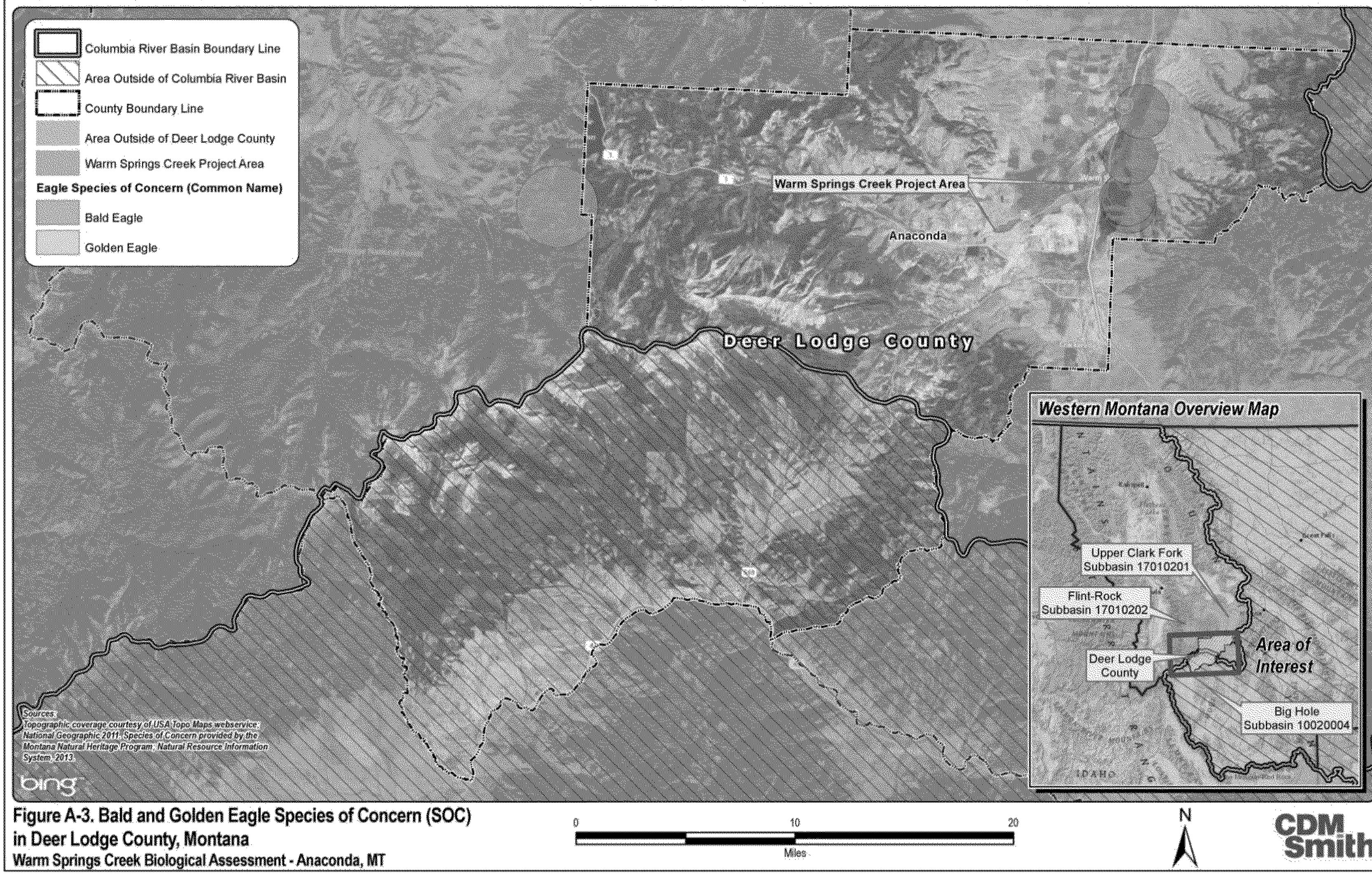

Figure A-3. Bald and Golden Eagle Species of Concern (SOC) in Deer Lodge County, Montana
Warm Springs Creek Biological Assessment - Anaconda, MT

CDM Smith

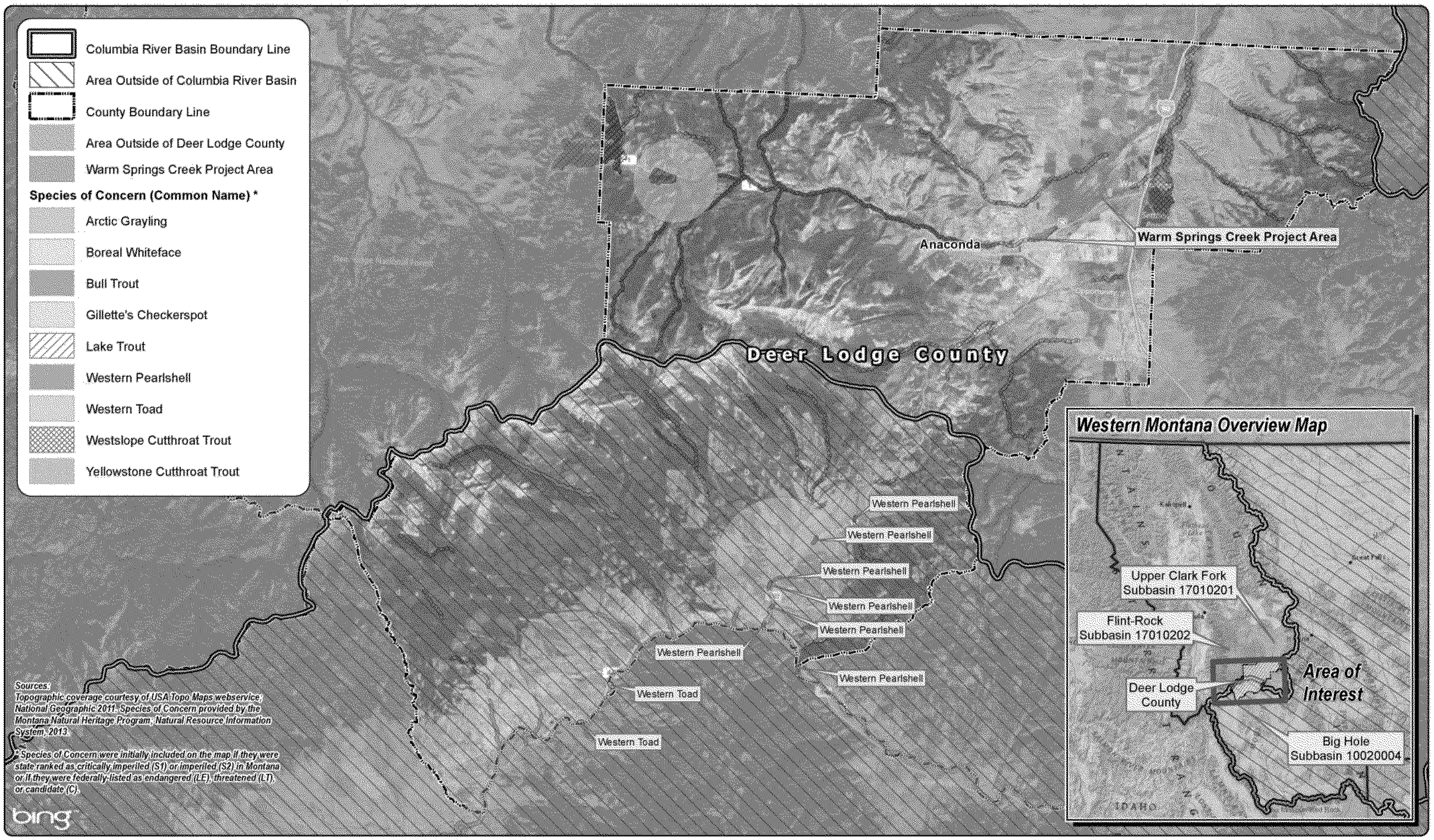

Figure A-4. Fish, Amphibian and Invertebrate Species of Concern (SOC) in Deer Lodge County, Montana
Warm Springs Creek Biological Assessment - Anaconda, MT

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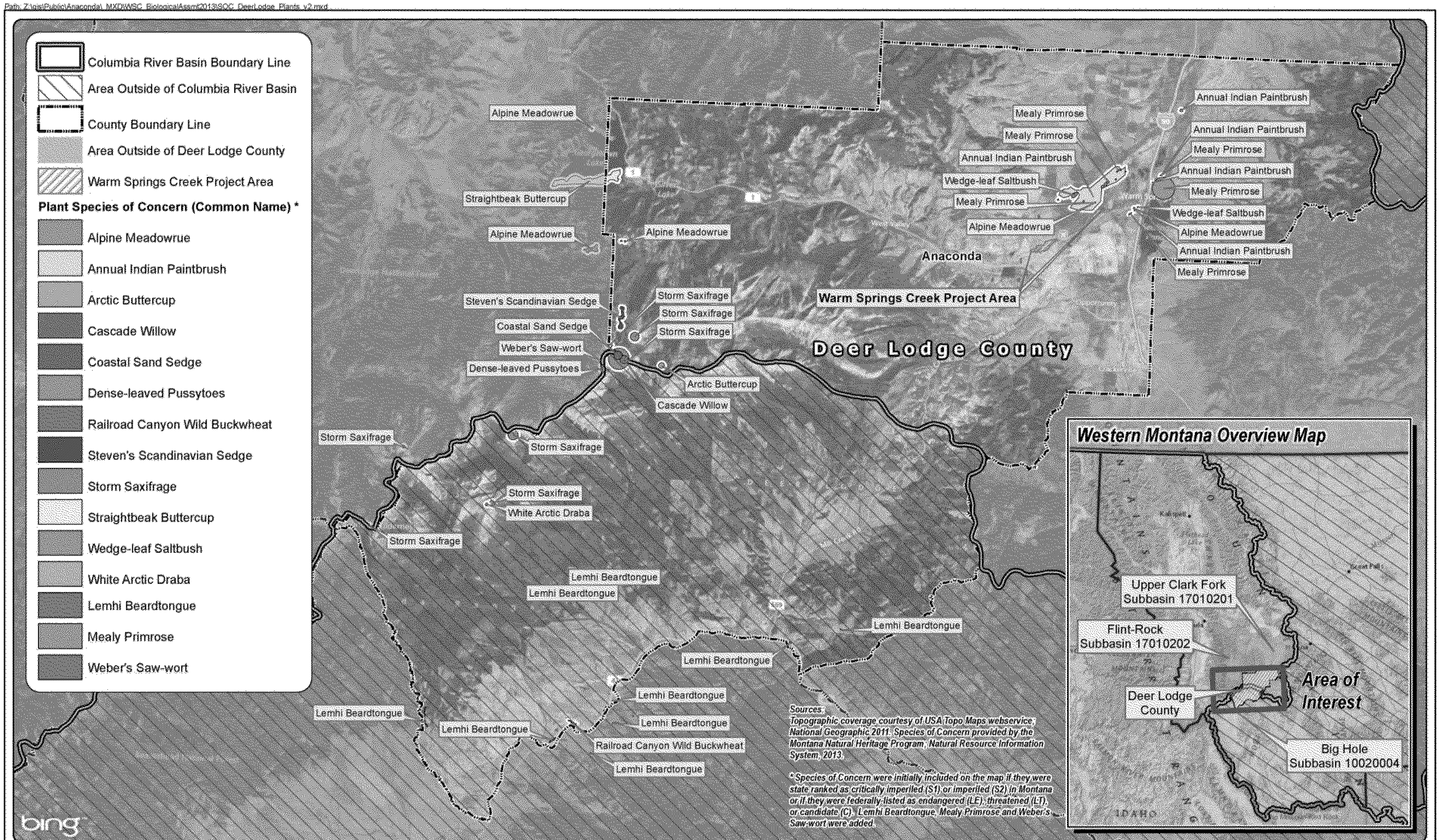

Figure A-5. Plant Species of Concern (SOC) in Deer Lodge County, Montana

Warm Springs Creek Biological Assessment - Anaconda, MT

CDM Smith